

Animal Markets and Zoonotic Disease in the United States



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ACKNOWLEDGMENTS

This research was made possible by the generous support of the Brooks Institute for Animal Rights Law & Policy through the Brooks Animal Studies Academic Network (BASAN). In addition to the Brooks McCormick Jr. Animal Law & Policy Program at Harvard and the Center for Environmental and Animal Protection at New York University, the BASAN member institutions that also provided resources and research assistance are the University of Denver's Animal Law Program, Lewis & Clark Law School's Center for Animal Law Studies, University of Toronto Faculty of Law, University of Victoria's Animals & Society Research Initiative, and Yale Law School's Law, Ethics & Animals Program.

We would also like to thank all of those who contributed their time, work, and expertise in contributing to this project, including: Michelle Amidzich, Isabella Ariza Buitrago, James Devitt, Becca Franks, Destiny Nneka Kanu, Diamond Leonard, Jackrabbit Design, Kelly Hesburn, Kari Linder, Jo-Anne McArthur, Eric Macomber, Kylie McDaniel, Kelley McGill, Viveca Morris, Sarah Pickering, Ceallaigh Reddy, George Steinmetz, and Nico Stubler.

Finally, thanks to the dozens of experts who sat in long and detailed interviews with us, sharing observations, experiences, and insights from their respective fields in order to assist in shedding more light on zoonotic disease risk in the United States. Thank you for your time, attention, and willingness to engage with our many questions.

IMAGES

Wherever possible the photographs used in this report depict practices inside the United States. However, given that many forms of animal industry are closed to the public or otherwise prohibit photography, in cases where no U.S. images were available, representative photographs were sourced from other countries, such as Canada, to depict analogous practices inside the United States.

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George Steinmetz

INTRODUCTION

There is a well-worn pattern in the face of emerging diseases whereby nations assign blame elsewhere, ignoring risks that lie closer to home. This practice of finger-pointing plays out on an international stage, while the accompanying “it can’t happen here” mentality stifles meaningful and much-needed domestic reform. Perhaps nowhere is this attitude more palpable than in the United States. For many Americans, concepts such as “bushmeat” or “wildlife farming” seem foreign, but they refer to practices that are common within the United States as well, differentiated only by the language we use to describe them.¹

More emerging infectious diseases originated in the United States than in any other country in the world during the second half of the 20th century.^{2,3,4} And it was the United States that was the likely source of the deadliest disease outbreak of recent record. The 1918 Influenza pandemic—a disease that infected roughly 500 million people, one-third of the world’s total population, killing 12 times as many in absolute terms as has COVID-19 to date—appears to have been born of humble origins deep in the American Heartland.^{5,6,7} The virus killed more Americans than World War I, World War II, and the

1. For example, Americans consume wild-caught animals, but refer to their type of meat as “game,” as opposed to “bushmeat” when referring to wild-caught animals eaten abroad. Americans also raise captive-bred wildlife species in great numbers, many for human consumption.
2. Reporting bias may explain part of this finding, as outbreaks are perhaps less likely to be noticed, reported, documented, and diagnosed in countries that lack sufficient health resources.
3. K. Jones, N. Patel, M. Levy et al., “Global Trends in Emerging Infectious Diseases” *Nature* 451 (2008): 990-993, <https://doi.org/10.1038/nature06536>.
4. Yewande Alimi, Jonathan Epstein, Manish Kakkar, Guilherme Werneck, “Report of the Scientific Task Force on Preventing Pandemics,” *Harvard Global Health Institute*, Harvard T.H. Chan School of Public Health, August 2021, <https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/08/PreventingPandemicsAug2021.pdf>.
5. At the time of this writing, this is true even without accounting for population size. Barry, John M. “The site of origin of the 1918 influenza pandemic and its public health implications,” *Journal of Translational Medicine* 2, No. 1 (Jan. 20 2004): 3, doi:10.1186/1479-5876-2-3.
6. “1918 Pandemic,” *Centers for Disease Control and Prevention*, last modified March 20, 2019, <https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html>.
7. “WHO Coronavirus (COVID-19) Dashboard,” *World Health Organization*, updated as April 19, 2023, <https://covid19.who.int/>.

Vietnam War, combined.^{8 9 10 11 12} Still, in 2023, the United States will spend 1,650 times more on military defense than on pandemic preparedness.¹³

More recently, in 2009, the influenza strain H1N1, known as “swine flu,” swept through the United States, infecting more than 100 million Americans and hospitalizing over 900,000.¹⁴ Two of the primary carriers of influenza, pigs and poultry, are produced in the United States by the millions and billions annually—with higher numbers of each than almost any other country on earth.^{15 16} The United States is also the largest importer of wildlife in the world, bringing more than 220 million live wild animals and their diseases across its borders each year.¹⁷ Yet, despite the serious risks and magnitude of disease exposure, the United States is not prepared to address these threats, many of which are chronically overlooked and under-regulated.

The United States, with its 3.8 million square miles of land, nearly 3,000 species of native wildlife, 10 billion livestock and poultry, and 328 million people, presents a massive and complex case study of how humans and other animals interact, often in the most intimate and artificial of ways.¹⁸ Animal use in the United States is as diverse as it is ubiquitous, though such use rarely permeates the public consciousness. While public-facing human-animal interactions may appear highly-controlled or sanitized, much of the larger picture falls outside this frame.

For example, by some estimates, there are as many exotic pets in the United States as there are cats and dogs, and many of these exotic pets are brought in from abroad, while others are bred out-of-sight in warehouses, backyards, and basements.^{19 20 21} Animals are everywhere, but much of the activity involving them goes unnoticed, concealed by opaque supply chains. There are 30 livestock animals

8. This is true even without accounting for population size. The CDC estimates that the 1918 pandemic killed 675,000 Americans, while 580, 135 servicemen and women died in WWI, WWII, and the Vietnam War according to the Department of Veterans Affairs. Roughly 392, 393 of these deaths occurred in combat. “America’s Wars,” *Department of Veterans Affairs*, last updated September 2019, https://www.va.gov/opa/publications/factsheets/fs_americas_wars.pdf.
9. Since the nation’s founding in 1775, there have been fewer deaths in combat (656,513) than deaths from the 1918 flu, which lasted just eighteen months. (This figure includes deaths in the American Civil War). “History of 1918 Flu Pandemic” *Centers for Disease Control and Prevention*, last modified March 21, 2018, <https://www.cdc.gov/flu/pandemic-resources/1918-commemoration/1918-pandemic-history.htm>.
10. “America’s Wars,” *Department of Veteran Affairs*, last modified May 2021, https://www.va.gov/opa/publications/factsheets/fs_americas_wars.pdf.
11. “Vietnam War U.S. Military Fatal Casualty Statistics,” *National Archives*, last updated August 23, 2022, <https://www.archives.gov/research/military/vietnam-war/casualty-statistics>.
12. John M. Barry, “The Site of Origin of the 1918 Influenza Pandemic and its Public Health Implications,” *Journal of Translational Medicine* 2, No. 1 (Jan. 20 2004): 3, doi:10.1186/1479-5876-2-3.
13. Referring to US Department of Defense’s fiscal year ending September 30. “The Department of Defense Releases the President’s Fiscal Year 2023 Defense Budget,” *U.S. Department of Defense*, March 28, 2022, <https://www.defense.gov/News/Releases/Release/Article/2980014/the-department-of-defense-releases-the-presidents-fiscal-year-2023-defense-budget/>.
14. “The Burden of the Influenza A H1N1 Virus Since the 2009 Pandemic,” *Centers for Disease Control and Prevention*, last modified June 10, 2019, <https://www.cdc.gov/flu/pandemic-resources/burden-of-h1n1.html>.
15. Over 9.5 billion chickens along with more than 125 million pigs are commercially processed in the U.S. in 2022. “Poultry—Production and Value 2020 Summary,” *USDA National Agricultural Statistics Service*, April 2021, https://www.nass.usda.gov/Publications/Todays_Reports/reports/plva0421.pdf; “Livestock Slaughter,” *USDA National Agricultural Statistics Service*, May 2022, https://www.nass.usda.gov/Publications/Todays_Reports/reports/lstk0522.pdf.
16. However, in addition to these “black swan” events, the United States, like the rest of the world, also struggles under the daily burden of common zoonotic diseases—endemic and often overlooked, but smoldering at a low level all of the time. For example, many well-known, endemic diseases, from salmonellosis to Lyme disease are transmissible from animals. The USDA estimated that the cost of salmonella infections alone cost the United States over \$4 billion annually, though this pathogen is just one of many that regularly cause illness. “Cost Estimates of Foodborne Illnesses,” *USDA*, last modified March 10, 2021, <https://www.ers.usda.gov/data-products/cost-estimates-of-foodborne-illnesses/>; A. Sanyaolu, C. Okorie, N. Mehraban, O. Ayodele, S.K. Tshitege et al., “Epidemiology of Zoonotic Diseases in the United States: A Comprehensive Review,” *J Infect Dis Epidemiol* 2:021 (2016), 10.23937/2474-3658/1510021.
17. “End Wildlife Trade: An Action Plan to Prevent Future Pandemics,” *Center for Biological Diversity*, Natural Resources Defense Council, Inc., May 2020, <https://www.nrdc.org/sites/default/files/end-wildlife-trade-202005.pdf>.
18. “Livestock & Meat Domestic Data,” *USDA*, last modified April 27, 2023, <https://www.ers.usda.gov/data-products/livestock-and-meat-domestic-data/livestock-and-meat-domestic-data/>.
19. Julie Lockwood, Dustin Welbourne, Christina M. Romagosa, Phillip Cassey et al, “When Pets Become Pests: The Role of the Exotic Pet Trade in Producing Invasive Vertebrate Animals,” *Frontiers in Ecology and Environment* 17, No. 6 (August 2019): 323—330, <https://doi.org/10.1002/fee.2059>.
20. “U.S. Pet Ownership Statistics,” *American Veterinary Medical Association*, accessed May 17, 2023, <https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics>.
21. E.A. Eskew, A.M. White, N. Ross, K.M. Smith, et al., “United States Wildlife and Wildlife Product Imports from 2000–2014,” *Scientific Data* 7, No. 1 (2020): <https://doi.org/10.1038/s41597-020-0354-5>.

Human-animal interactions have given and will again give rise to zoonotic outbreaks that claim American lives.

produced annually for every person in the United States, yet only a handful of us interact with them directly. Still, when disease outbreaks spill over, they have the potential to extend far beyond these few individuals. Human-animal interactions have given and will again give rise to zoonotic outbreaks that claim American lives.

Zoonotic disease experts with whom we spoke likened disease outbreaks to forest fires, with large populations of wild and captive animals representing dried-out trees and kindling. The

purpose of this discussion is to examine the sparks—the actions we take that can and have given rise to outbreaks of zoonotic disease.²² Some of these actions are deliberate, while others are as careless as flicking a cigarette butt out of a car window.

We catalog and assess the scope of animal commerce in the United States, noting the kinds of transactions that can act as flashpoints for zoonotic spillover, an event through which pathogens are transmitted from animals to humans. In this report, we identify 36 distinct types of consumer-facing animal markets and supply chains, documenting the risks and the regulatory landscape surrounding each. Underpinning this research are two driving questions: Does the practice in question pose a risk of zoonotic transmission? And if so, is current regulation sufficient to mitigate that risk?

We begin with a discussion of sources: the supply-side markets that fuel animal industries. From there, we discuss a range of consumer-facing animal markets.²³ While some of these markets are well documented, others operate almost entirely out of view—of both the public and, often, of regulators too. We hope to bring these under-examined markets into clearer focus and, with them, the endless, dizzying array of ways Americans use and consume animals. A number of observations about existing policy emerged from our research that cut across and color multiple markets, helping to illuminate the institutional, informational, behavioral, and enforcement challenges that characterize U.S. regulatory postures.

At the end of this discussion, we are left with the uneasy but unavoidable conclusion that, at present, the United States has no comprehensive strategy to mitigate zoonotic risk. While zoonotic risk cannot be eliminated, it can be reduced. Closer examination of these policy insights may foster ideas regarding how regulation can be better conceptualized and designed both to reflect and reduce such risk. This report provides a springboard for such conversations and begins laying the groundwork for much-needed reform. Recognizing the risks is an important first step, for only then will we be able to make clear-eyed appraisals of whether each practice is worth the danger it poses and what might be done to tip the scales in favor of prevention.

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22. Reverse zoonoses can amplify these threats when humans infect animals, creating dangerous spillback loops and driving the emergence of new and dangerous forms of disease. Kirstin Spence, “What is Reverse Zoonosis,” *News Medical*, last modified November 11, 2021, <https://www.news-medical.net/health/What-is-Reverse-Zoonosis.aspx>.

23. Though the list of markets included here is not exhaustive, it is intended to provide some sample of the types and forms that animal-based commerce takes in the United States.



Jo-Anne McArthur / We Animals Media

CONTEXT AND CULTURAL USE OF ANIMALS

Globally, the United States is an epicenter of demand for animals and animal products. High levels of wealth and demand per capita, combined with the sheer population of the United States, make the country a premier consumer market for animals. The United States is the world's largest importer of both domestic animals and of wildlife.²⁴

In 2019, the United States legally imported more than 224 million live wild animals and 883 million wildlife products worth over \$4.3 billion.^{25 26 27} In addition, over 22 million livestock animals were imported, at a value of roughly \$3.5 billion.^{28 29 30} With these animals comes the potential for new disease outbreaks.

The United States' role in fueling the emergence of zoonotic disease manifests itself in two ways: the problems it creates here and the problems it places elsewhere. Wealth and consumption habits in the United States drive extractive practices in search of animals and animal products across much of the

24. Tom Levitt, "Two Billion and Rising: The Global Trade in Live Animals in Eight Charts," *The Guardian*, January 20, 2020, <https://www.theguardian.com/environment/2020/jan/20/two-billion-and-rising-the-global-trade-in-live-animals-in-eight-charts>. Most of this report is based on UN Food and Agriculture Organization data.
25. Roughly three in four of these animals were captured from the wild, with the other 25 percent born in captive breeding facilities overseas. "End Wildlife Trade: An Action Plan to Prevent Future Pandemics," *Center for Biological Diversity and Natural Resources Defense Council, Inc.*, last modified May 2020, <https://www.nrdc.org/sites/default/files/end-wildlife-trade-202005.pdf>.
26. K. M. Smith, C. Zambrana-Torrel, A. White, M. Asmussen, et al., "Summarizing US Wildlife Trade with an Eye Toward Assessing the Risk of Infectious Disease Introduction," *Ecohealth* 14, No. 1 (2017): 29-39, doi: 10.1007/s10393-017-1211-7.
27. "Law Enforcement at a Glance," *U.S. Fish and Wildlife Service*, last modified March 28, 2020, <https://www.documentcloud.org/documents/6843670-U-S-Fish-and-Wildlife-Service-Law-Enforcement-at>.
28. The United States imports 8-12% of the beef Americans eat. This meat is often almost indistinguishable in the supermarket and can sometimes be labeled "Product of the U.S.A." Jennifer Whitlock, "USDA to Review 'Product of USA' Label," *Texas Farm Bureau*, July 6, 2021, <https://texasfarmbureau.org/usda-to-review-product-of-usa-label/>.
29. Carys Bennett, "The Live Animal Trade In The U.S.: A Review," *Faunalytics*, September 13, 2018, <https://faunalytics.org/the-live-animal-trade-in-the-u-s-a-review/#>.
30. "Livestock and Meat International Trade Data," *USDA Economic Research Service*, accessed May 4, 2023, <https://www.ers.usda.gov/data-products/livestock-and-meat-international-trade-data/>.

developing world that, in turn, drive spillover risk upstream in the supply chain. A South American farmer on the Gulf of Mexico may climb a tree and collect Amazon parrot nestlings, place them in plastic water bottles, and smuggle them into the United States for sale.³¹ A bat in Indonesia may be captured in a net trap, encased in plastic, and shipped to the United States in the form of a paperweight.³² Other types of consumer demand can also play an indirect role in precipitating zoonotic disease spread abroad. For example, America's dependence on heavy metals to build laptop computers necessitates intensive mining in central Africa, and in the process, creates opportunities for deadly viruses such as Marburg, a cousin to Ebola with a fatality rate of 80%, to spill over from fruit bats to gold miners.^{33,34} Yet, wherever a disease originates, it can arrive in the United States by plane within 24 hours.

Wealth and consumption habits in the United States drive extractive practices in search of animals and animal products across much of the developing world that, in turn, drive spillover risk upstream in the supply chain.

Most wildlife is imported legally into the United States without disease testing or any kind of physical inspection.

Further, most wildlife is imported legally into the United States without disease testing or any kind of physical inspection. These animals go on to live in our homes—in our backyards, basements, and bathrooms, kept as exotic pets. Others are displayed in roadside zoos or processed for their parts and products. Some estimates suggest nearly 80% of these imported animals are captured from the wild, with the rest bred overseas in captive breeding facilities.³⁵ They have brought with them new diseases—mpox (previously known as “monkeypox”), parrot fever, Herpes B, Ebola-Reston and others—infesting both their owners and native wildlife populations.^{36,37}

The United States is also a leading producer of animals, domestically breeding both livestock and captive wildlife in great numbers. While captive-wildlife breeding spans a wide range of species, livestock breeding concentrates on only a handful of species, predominantly chickens, cows, and pigs. Over 10 billion land animals are produced in the United States for human consumption each year, a number that continues to rise, sometimes by as much as 200 million animals per year.³⁸ Forty-one percent of the land in the United States is dedicated to livestock production—with one-third of the

31. Jose Gobbi, Debra Rose, Gina De Ferrari, Leonora Sheeline, “Parrot Smuggling Across the Texas-Mexico Border,” *World Wildlife Fund-US*, June 1996, https://www.traffic.org/site/assets/files/5534/parrot_smuggling_across_the_texas-mexico_border.pdf.

32. These types of items are, by far, the most common commercial purpose for bats coming into the United States and 93% of bats and bat products entering the country are sourced from the wild. These types of practices undermine biodiversity and ecosystem health. Tanya Sanerib and Sarah Uhlemann, “Dealing in Disease: How U.S. Wildlife Imports Fuel Global Pandemic Risks,” *Center for Biological Diversity*, September 2020, https://www.biologicaldiversity.org/programs/international/pdfs/Dealing-in-Disease_Center-wildlife-imports-report-9-28-20.pdf.

33. Adrian Burton, “Marburg Miner Mystery,” *The Lancet Infectious Diseases* 4, No. 2 (February 2004): 67, [https://doi.org/10.1016/S1473-3099\(04\)00917-X](https://doi.org/10.1016/S1473-3099(04)00917-X).

34. Daniel G. Bausch, Stuart T. Nichol, Jean-Jacques Muyembe-Tamfum et al., “Marburg Hemorrhagic Fever Associated with Multiple Genetic Lineages of Virus,” *The New England Journal of Medicine* 355 (August 31, 2006): 909-919, <https://doi.org/10.1056/NEJMoa051465>.

35. E.A. Eskew, A.M. White, N. Ross et al., “United States Wildlife and Wildlife Product Imports from 2000–2014,” *Sci Data* 7, No. 22 (2020): <https://doi.org/10.1038/s41597-020-0354-5>.

36. B.I. Pavlin, L.M. Schloegel, and P. Daszak, “Risk of Importing Zoonotic Diseases through Wildlife Trade, United States” *Emerging Infectious Diseases*, 15, No. 11 (2020): 1721–1726, doi:10.3201/eid1511.090467.

37. Each year the United States exports native wildlife as well. For example, in 2018, the United States exported 1.4 million turtles, many of which went to China and Hong Kong for human consumption. “Case Study: U.S. Freshwater Turtles and Tortoises,” *Association of Fish & Wildlife Agencies*, 2020, https://www.fishwildlife.org/application/files/7815/9352/0162/Case_Study_U.S._Freshwater_Turtles_and_Tortoises_CITES_2020_FINAL.pdf.

38. “Livestock and Meat Domestic Data,” *USDA Economic Research Service*, last updated April 27, 2023, <https://www.ers.usda.gov/data-products/livestock-and-meat-domestic-data/>.

country's area occupied by livestock, while another 8% of the country is used to grow feed to maintain the livestock.³⁹ Today, the majority of crops grown in the United States are not fed to humans, but to animals.⁴⁰ Producing these crops requires significant amounts of water. Cattle feed production alone accounts for 23% of total U.S. water use, 32% of water use in the Western United States, and 55% in the Colorado River basin, which supplies water to 40 million people across seven states.⁴¹



Americans eat more meat per capita than any other country in the world and almost twice as much as most—214 lbs per person annually.⁴² To supply this tremendous demand, the United States employs an intensive, industrialized system of animal production. Over 98% of U.S.-produced livestock comes from 21,000 highly-concentrated factory farms.^{43 44 45} A single facility can contain more than five million animals, a headcount greater than the human population of 27 of the 50 states.⁴⁶ While this model of animal production limits some aspects of disease risk, it amplifies others. Disease outbreaks at these facilities can happen regularly—and on an immense scale. In 2015, for example, 50 million laying hens were killed to contain the spread of highly pathogenic avian influenza, costing taxpayers one billion dollars.^{47 48 49} In 2022, a similar strain moved through commercial flocks in the United States, reaching 46 states and resulting in the death of over 57 million birds.^{50 51 52}

39. This estimate includes only the continental United States and does not account for land use in Alaska or Hawaii. Dave Merrill and Lauren Leatherby, "Here's How America Uses Its Land," *Bloomberg*, July 31, 2018, <https://www.bloomberg.com/graphics/2018-us-land-use/>.
40. Emily S. Cassidy, Paul C West, James S Gerber and Jonathan A Foley, "Redefining Agricultural Yields: From Tonnes to People Nourished per Hectare" *Environ. Res. Lett.* 8 (2013): 034015, <https://iopscience.iop.org/article/10.1088/1748-9326/8/3/034015/pdf>.
41. Brian D. Richter, Dominique Bartak, Peter Caldwell, Kyle Frankel Davis, et al., "Water Scarcity and Fish Impairment Driven by Beef Production," *Nature Sustainability* 3 (2020): 319-328.
42. Rob Smith, "These Are the Countries That Eat the Most Meat," *World Economic Forum*, August 29, 2018, <https://www.weforum.org/agenda/2018/08/these-countries-eat-theeat-03bdf469-f40a-41e3-ade7-fe4ddb2a709a/>.
43. Calculations are based on USDA Census of Agriculture Data. Jacy Reese Anthis, "U.S. Factory Farming Estimates," *Sentience Institute*, April 11, 2019, <https://www.sentienceinstitute.org/us-factory-farming-estimates>.
44. CAFOs are regulated under the National Pollutant Discharge Elimination System (NPDES) of the EPA. "Animal Feeding Operations (AFOs)," *United States Environmental Protection Agency*, last updated February 16, 2023, <https://www.epa.gov/npdes/animal-feeding-operations-afos>.
45. Christopher Walljasper, "Large Animal Feeding Operations On the Rise," *MidWest Center for Investigative Reporting*, June 7, 2018, <https://investigatmidwest.org/2018/06/07/large-animal-feeding-operations-on-the-rise/>.
46. Associated Press, "Bird Flu Case Forces Killing of 5.3 Million Chickens in Iowa," *We Are Iowa*, March 18, 2022, <https://www.weareiowa.com/article/life/animals/avian-bird-flu-case-forces-killing-of-53-million-chickens-in-iowa-buena-vista-county/524-e1686b3a-13cd-4688-ad1e-47f37ee56e3b>.
47. The USDA has established agreements with growers to compensate them for culled flocks. The culling and disposal of flocks from the 2015 outbreak is estimated to have cost \$1 billion. Ali Khan and William Patrick, *The Next Pandemic: On the Front Lines Against Humankind's Gravest Dangers*, (New York: Perseus Books, 2016), chap. 6, Apple Books.
48. Meat production is also concentrated geographically with four states—Iowa, Kansas, Nebraska, and Texas—accounting for roughly half of U.S. red meat production, while most poultry production takes place in the Southeast and Iowa. "Broiler Chicken Industry Key Facts 2019," *National Chicken Council*, accessed May 31, 2023, <https://www.nationalchickencouncil.org/about-the-industry/statistics/broiler-chicken-industry-key-facts/>.
49. "Livestock Slaughter 2020 Summary," *USDA*, last modified April 2021, https://www.nass.usda.gov/Publications/Todays_Reports/reports/lisan0421.pdf.
50. "U.S. Approaches Record Number of Avian Influenza Outbreaks in Wild Birds and Poultry," *Centers for Disease Control and Prevention*, last modified November 3, 2022, <https://www.cdc.gov/flu/avianflu/spotlights/2022-2023/hearing-record-number-avian-influenza.htm>.
51. "2022 Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks," *USDA*, last modified April 21, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-commercial-backyard-flocks>.
52. One production facility alone in Buena Vista County, Iowa had 5,300,000 infected or presumed infected birds. Associated Press, "Bird Flu Case Forces Killing of 5.3 Million Chickens in Iowa," *We Are Iowa*, March 18, 2022, <https://www.weareiowa.com/article/life/animals/avian-bird-flu-case-forces-killing-of-53-million-chickens-in-iowa-buena-vista-county/524-e1686b3a-13cd-4688-ad1e-47f37ee56e3b>.

The scale of animal use in the United States is partly a function of cultural values. Dominion over and use of animals, both wild and domestic, is a central tenet of America's cultural identity as well as the nation's dominant religions. Underpinning these traditions are the ideological remains of "manifest destiny," a desire to settle the continent and subdue its inhabitants. For the most part, nature in the United States is not valued intrinsically, but for its ability to meet real and apparent human needs.

The United States prides itself on its capitalist economy, cultural independence, and perceived strength. These values present unique regulatory challenges and, occasionally, obstacles to collective action. While some types of animal use are highly regulated in the United States, most are not.



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REGULATORY OVERSIGHT










Animal markets in the United States are managed by a patchwork of regulations at the federal, state, and local levels. Each of the 50 states is free to create its own legislation, so long as the state law does not conflict with federal legislation. States typically can impose regulations that are more, but not less, stringent than federal law. While the federal government's authority is limited to those powers enumerated and granted by the U.S. Constitution, states enjoy broad power to regulate for the general welfare of their citizens.⁵³ Where no relevant federal regulations exist or where regulations are inadequately enforced, state and local governments play an outsized role in managing animal markets and zoonotic outbreaks.

There is no single, unified federal or state authority responsible for the prevention, detection, and regulation of zoonotic disease. Rather, regulatory authority is divided among different government agencies, each tasked with overseeing particular types of animals or activities. Often, these distinctions are made along arbitrary lines.

There is no single, unified federal or state authority responsible for the prevention, detection, and regulation of zoonotic disease.

53. There are some limitations to this principle. For example, "some states operate with what is known as the Dillon rule which says that localities only possess those powers that have been specifically granted to them by the state legislature. In contrast, in home-rule states, local governments have discretion to make a wide range of policy decisions without direction by the state." Mark Rozell, Clyde Wilcox "What State and Local Governments Do," in *Federalism: A Very Short Introduction* (New York: Oxford University Press, 29), 57.

Regulatory Oversight of Animals in the United States

	Federal Level					State Level			Unregulated
Authority	Department of Agriculture	Department of Interior	Department of Commerce	Department of Health and Human Services	Department of Homeland Security	Department of Agriculture	Department of Fish and Game	Department of Health	N/A
									
Primary Focus	Livestock	Wildlife	Marine Life	Food Safety and Disease Control	National Security and Border Control	Livestock	Wildlife	Companion Animals	None
Related Agencies	Animal and Plant Health Inspection Service (APHIS) Food Safety and Inspection Service (FSIS)	Fish and Wildlife Service (FWS) US Geological Survey (USGS)	National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)	Centers for Disease Control and Prevention (CDC) US Food and Drug Administration (FDA)	US Customs and Border Protection (CBP)	Varies by state	Varies by state	Varies by state	None
Related Legislation	Animal Welfare Act The Animal Health Protection Act Poultry Products Inspection Act Federal Meat Inspection Act	Endangered Species Act Captive Wildlife Safety Act Lacey Act	Marine Mammal Protection Act	Public Health Service Act Federal Food, Drug, and Cosmetic Act	Enforces the Laws of Other Agencies	Varies by state	Varies by state	Varies by state	None

These agencies operate like puzzle pieces from different puzzles. The result is a poorly-interlocking system whereby animals are divided into artificial categories and governed along similarly arbitrary divisions of administrative authority.⁵⁴ Troublespots and gaps arise when animals are governed by regulatory categories such as “wildlife” or “livestock” but do not fit neatly into either category.⁵⁵ While disease can jump freely from wildlife to livestock to humans and back, the U.S. regulatory system struggles to exercise this same kind of flexibility. And because zoonotic disease touches on many different policy areas—including human health, environmental health, and animal health—it often falls on the fault lines between agencies, resulting in a lack of unified and comprehensive government action.

While disease can jump freely from wildlife to livestock to humans and back, the U.S. regulatory system struggles to exercise this same kind of flexibility.

54. For example, marine fish fall under the Department of Commerce, while freshwater fish fall under the Department of the Interior.
 55. For example, the USDA considers fur-bearing animals such as minks to be outside of their purview, while the FWS considers them farmed animals and does not regulate such operations. These blindspots are particularly pronounced around captive wildlife breeding, an industry that enjoys relatively scant regulatory oversight, despite posing some of the most serious risks of zoonotic transmission.

Agencies rarely work closely in concert with one another, and when they do, it is often an uncomfortable marriage. Diverse agency interests, cultures, and mandates act as barriers to collaboration, as do logistical obstacles that make information and data sharing more difficult. The result, too often, is siloing—a lack of coordinated effort and a piecemeal approach to policy making. Budget shortages and understaffing amplify these problems and make it difficult for officials to handle the sheer volume of animals they oversee.

To further complicate matters, animals are regulated differently from one state to the next and differently within states depending on their function.⁵⁶ These discrepancies, both with respect to whether activities are regulated and by whom, can result in confusion within and across states, creating opportunities for disease to pass undetected into and through the United States.

Federal Agencies

At the federal level, most native free-ranging wildlife, as well as wildlife imports, fall under the jurisdiction of the Department of the Interior's U.S. Fish and Wildlife Service (FWS) whose mandate is to manage fish, wildlife, and natural habitats. However, the agency's mission does not include disease control, but instead focuses primarily on enforcing conservation regulations.⁵⁷ The FWS import inspectors only physically inspect a fraction of the live animals coming into the United States, approving the rest on paperwork alone. Furthermore, the FWS inspectors have no independent legal authority to test incoming wildlife for disease.⁵⁸

The FWS operates with only 113 inspectors distributed across major international airports, ocean ports, and border crossings, tracking millions of wildlife imports valued at \$4.3 billion annually.⁵⁹⁶⁰ The port of Los Angeles, which imports and exports more wildlife than any other U.S. port, employed only six FWS inspectors to monitor the port's seven airports and seaports in 2020.⁶¹

Also under the Department of Interior is the U.S. Geological Survey (USGS), the Department's sole scientific arm. The USGS researches wildlife health and carries out disease testing for mass mortality events among wildlife. However, USGS does not have the ability to promulgate regulations.

Unlike other native wildlife, marine fisheries and marine mammals are regulated by the Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA).



56. For example, exotic animals in Texas are treated as livestock for certain regulatory purposes, a classification that enables them to be hunted on captive hunting preserves. Yet, the state simultaneously exempts exotic animals from slaughter regulations typically enforced on livestock.

57. Robert Wallace, "Oversight of FWS: US Fish and Wildlife Services: Testimony of Department of the Interior before the Senate Committee on Environment and Public Works regarding the U.S. Fish and Wildlife Service," *U.S. Department of Interior*, February 5, 2020, <https://www.doi.gov/oc/oversight-fws>.

58. However, the FWS is sometimes tasked with carrying out directives imposed by other agencies such as the USDA or CDC.

59. "Law Enforcement at a Glance," *U.S. Fish and Wildlife Service*, last modified March 28, 2020, <https://www.documentcloud.org/documents/6843670-U-S-Fish-and-Wildlife-Service-Law-Enforcement-at.html>.

60. This budget allocation is a small fraction of the FWS total annual budget of \$1.56 billion in discretionary funding. R Eliot Crafton, "U.S. Fish and Wildlife Service: FY2019 Appropriations," *Congressional Research Service*, IF10846 v 6, last modified May 2, 2019, <https://fas.org/sgp/crs/misc/IF10846.pdf>.

61. Rachel Nuwer, "Many Exotic Pets Suffer or Die in Transit, and Beyond—and the U.S. Government is Failing to Act," *National Geographic*, March 2, 2021, <https://www.nationalgeographic.com/animals/article/exotic-pets-suffer-wildlife-trade>.

NOAA is involved with climate modeling for future zoonotic disease outbreaks and investigates unusual mortality events in marine life.

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) is the agency responsible for ensuring the health of livestock animals including cattle, poultry, sheep, and swine.⁶² The USDA enforces legislation related to biosecurity measures, slaughtering protocols, and food safety. The USDA is also responsible for inspecting millions of livestock at the border, as well as meat imports, to prevent foreign animal diseases from entering into the U.S. food system.⁶³ APHIS inspects live animal imports at 15 land ports along the Mexican border, 20 land ports at the Canadian border, and 30 airports across the United States.⁶⁴ The agency determines the inspection intensity based on the associated disease risk for both the animal type and exporting country, yet diseases can escape detection, especially when only a small percentage of animals are tested.⁶⁵ Testing also is limited in domestic production.⁶⁶

The USDA maintains a list of “notifiable diseases” which, if detected by a lab or veterinarian, must be reported to state health officials, who then relay that information to the USDA.⁶⁷ Significant governmental resources are dedicated to protecting agricultural animals because of their economic value and the potentially devastating consequences of a disease outbreak.

APHIS is also tasked with regulating both wild and domestic animals used in research, entertainment, zoos, commercial breeding facilities, and a collection of other industries under the Animal Welfare Act. However, this legislation exempts most farmed animals, most animals used in research, as well as many other types of animals and animal operations.⁶⁸

The USDA's Food Safety Inspection Service (FSIS) oversees the slaughter and processing of livestock, as well as the packaging and sale of most livestock products. About 7,800 FSIS inspectors staff 6,800 federally inspected meat processing plants, which together slaughter more than 9.9 billion animals per year.^{69 70 71} However, the USDA generally does not regulate livestock animals until this last stage of production. The USDA maintains that it has no authority to regulate the treatment of livestock prior to slaughter, for example.^{72 73 74 75}

62. The USDA only oversees poultry operations with more than 1000 chickens.

63. While APHIS manages live animal imports, USDA's Food Safety Inspection Services oversees meat and animal product imports.

64. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, Report GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

65. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, Report GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

66. For example, with respect to Bovine spongiform encephalopathy (i.e. “mad-cow disease”), the USDA notes that, “The goal of our BSE surveillance program... has never been to detect every case of BSE.” “BSE Surveillance Information Center,” *USDA*, accessed May 31, 2023, <https://www.usda.gov/topics/animals/bse-surveillance-information-center>.

67. 9 CFR Part 161.4(f) For a full list, see: https://www.aphis.usda.gov/animal_health/monitoring_surveillance/nlrad-system-standards.pdf.

68. Animal Welfare Act, 7 U.S.C 54 §2131.

69. “Don't Let Your Outdoor Meal Become a Feast for Bacteria,” *USDA Food Safety and Inspection Service*, accessed May 24, 2023, <https://www.fsis.usda.gov/>.

70. “Slaughter Inspection 101,” *USDA Food Safety and Inspection Service*, last updated August 9, 2013, <https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/slaughter-inspection-101>.

71. “Livestock Slaughter Annual Summary,” *USDA Economics, Statistics, and Market Information System*, April 29, 2023, <https://usda.library.cornell.edu/concern/publications/r207tp32d>.

72. However, the agency is tasked with enforcing the “Twenty-Eight Hour Law” which requires transporters to offload animals to provide them food and water if being transported by truck for more than twenty-eight consecutive hours.

73. National Agriculture Library, “Whom Do I Contact About Inhumane Treatment of Farm Animals?” *USDA*, accessed May 31, 2023, <https://www.nal.usda.gov/animal-health-and-welfare/animal-welfare-act>.

74. Renée Johnson, “Food Safety on the Farm: Federal Programs and Legislative Action,” *Congressional Research Service*, Report RL34612, December 15, 2010, <https://sgp.fas.org/crs/misc/RL34612.pdf>.

75. Cynthia Brougher, “USDA Authority to Regulate On-Farm Activity,” *Congressional Research Service*, Report R40577, May 12, 2009, https://www.everycrsreport.com/files/20090512_R40577_6b8d3e6d6fa98602296460753656690cdcc4163d.pdf.

The Department of Health and Human Services' Centers for Disease Control and Prevention (CDC) imposes regulations governing select species including dogs, turtles, civets, African rodents, bats, and nonhuman primates.⁷⁶ The agency's focus is on protecting human health, and it can place restrictions, bans, quarantines, or increased permitting requirements for any species considered a public health threat.⁷⁷ While the CDC has broad legal authority to prevent infectious diseases from entering or moving within the United States, it regulates animals only sparingly.⁷⁸ Each of the CDC's species-specific regulations was imposed in response to a particular zoonotic disease outbreak for which those animals are known carriers. However, CDC regulations, in covering only a small handful of species, exclude thousands more that carry these same diseases or others. In most cases, the CDC relies on other agencies such as the USDA to enforce its regulations in markets and at ports of entry as it cannot provide enough staff itself to carry out these inspections.⁷⁹

While the CDC has broad legal authority to prevent infectious diseases from entering or moving within the United States, it regulates animals only sparingly.

Last, the Department of Homeland Security's U.S. Customs and Border Protection (CBP) works in coordination with the FWS, the USDA, the CDC, and a range of local agencies to regulate entry and exit of shipments of live animals and animal products at the border. Upon arrival to the United States, CBP holds and refers the shipment to the responsible agency or agencies.⁸⁰

State Agencies

In addition to these federal agencies, each state has its own slate of administrative agencies. Among these are departments of wildlife, departments of agriculture, and departments of public health (though the titles of each may vary from one state to the next).

Free-roaming wildlife is regulated predominately at the state level. State wildlife agencies own, manage, or regulate 464 million acres of land and 167 million acres of lakes, rivers and wetlands.⁸¹ Collectively, these agencies operate on an annual budget of \$5.6 billion with approximately 50,000 employees.⁸² Their primary function is to oversee and promote hunting and fishing, which constitutes their largest source of revenue through license sales.⁸³

76. The CDC notes on their website that the agency regulates cats but a general certificate of health is not required (though some states and airlines do require these health certificates. "Bringing an Animal into the United States," *Centers for Disease Control and Prevention*, last modified January 11, 2022, <https://www.cdc.gov/importation/bringing-an-animal-into-the-united-states/index.html>.

77. Section 361 of the Public Health Service Act, 42 U.S. Code § 264.

78. This authority is given to the Department of Health and Human Services and shared by both the CDC and FDA. 42 U.S. Code § 264.

79. "Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases," *United States Government Accountability Office*, Report GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

80. "Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases," *United States Government Accountability Office*, Report GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

81. Larry Voyles and Loren Chase, "The State Conservation Machine," *Association of Fish & Wildlife Agencies and the Arizona Game and Fish Department*, 2017, https://www.fishwildlife.org/application/files/3615/1853/8699/The_State_Conservation_Machine-FINAL.pdf.

82. Larry Voyles and Loren Chase, "The State Conservation Machine," *Association of Fish & Wildlife Agencies and the Arizona Game and Fish Department*, 2017, https://www.fishwildlife.org/application/files/3615/1853/8699/The_State_Conservation_Machine-FINAL.pdf.

83. Larry Voyles and Loren Chase, "The State Conservation Machine," *Association of Fish & Wildlife Agencies and the Arizona Game and Fish Department*, 2017, https://www.fishwildlife.org/application/files/3615/1853/8699/The_State_Conservation_Machine-FINAL.pdf.

Due to how these agencies are structured in terms of both funding and agency composition, they tend to favor consumptive uses of wildlife (i.e., those that involve killing the animal) over non-consumptive uses, even though only 3%–4% of the American public engages in hunting.^{84 85 86}

State departments of agriculture promote and regulate ranching and agribusiness within the states. These departments are also tasked with overseeing food safety as well as the movement of animals to and across state lines. While these agencies generally do not address the treatment or handling of livestock animals, they sometimes have broad discretion to regulate animal health and may implement protocols for reducing the spread of infectious disease.⁸⁷ In addition, they are required to report the detection of certain diseases to the USDA.

By contrast, state and local departments of public health regulate animals in very limited ways. They may impose sanitation guidelines involving whether animals are allowed in restaurants, or specific requirements for rabies vaccinations, for example, as well as laws governing the ownership of dangerous animals.⁸⁸ However, departments of public health tend to be involved primarily after a zoonotic outbreak has happened, focusing more on response than prevention.



84. Many state agencies require that a majority of state wildlife board seats are held by consumptive users (hunters, fishermen, and trappers), rather than non-consumptive users such as wildlife watchers, scientists, or others. Some states go so far as to prohibit non-consumptive users from serving on the state boards that govern wildlife policy. The result is a “value gap” between those setting wildlife policy and the public at large. Estimates suggest that hunters are over-represented in policy decision-making roles by a factor of 18x (with 75% of commissioners hunting compared to roughly 3-4% of the general public). “2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation,” *U.S. Fish and Wildlife Service*, October 2018, <https://www.census.gov/content/dam/Census/library/publications/2018/demo/fhw16-nat.pdf>.
85. MJ Manfredo, L. Sullivan, A.W. Don Carlos et al, “America’s Wildlife Values: The Social Context of Wildlife Management In the U.S.,” *National Report from the Research Project America’s Wildlife Values*, Colorado State University, Department of Human Dimensions of Natural Resources, 2018 <https://sites.warnercnr.colostate.edu/wildlifevalues/wp-content/uploads/sites/124/2019/01/AWV-National-Final-Report.pdf>.
86. “Overview of State Wildlife Management,” *Wildlife For All*, 2022, <https://wildlifeforall.us/resources/overview-state-wildlife-management/>.
87. “Animal Health Division,” *North Dakota Department of Agriculture*, accessed May 31, 2023, <https://www.ndda.nd.gov/divisions/animal-health>.
88. “Emerging and Zoonotic Infectious Disease Laws,” *Centers for Disease Control and Prevention*, last modified January 5, 2023, <https://www.cdc.gov/php/publications/topic/zoonotic.html>.

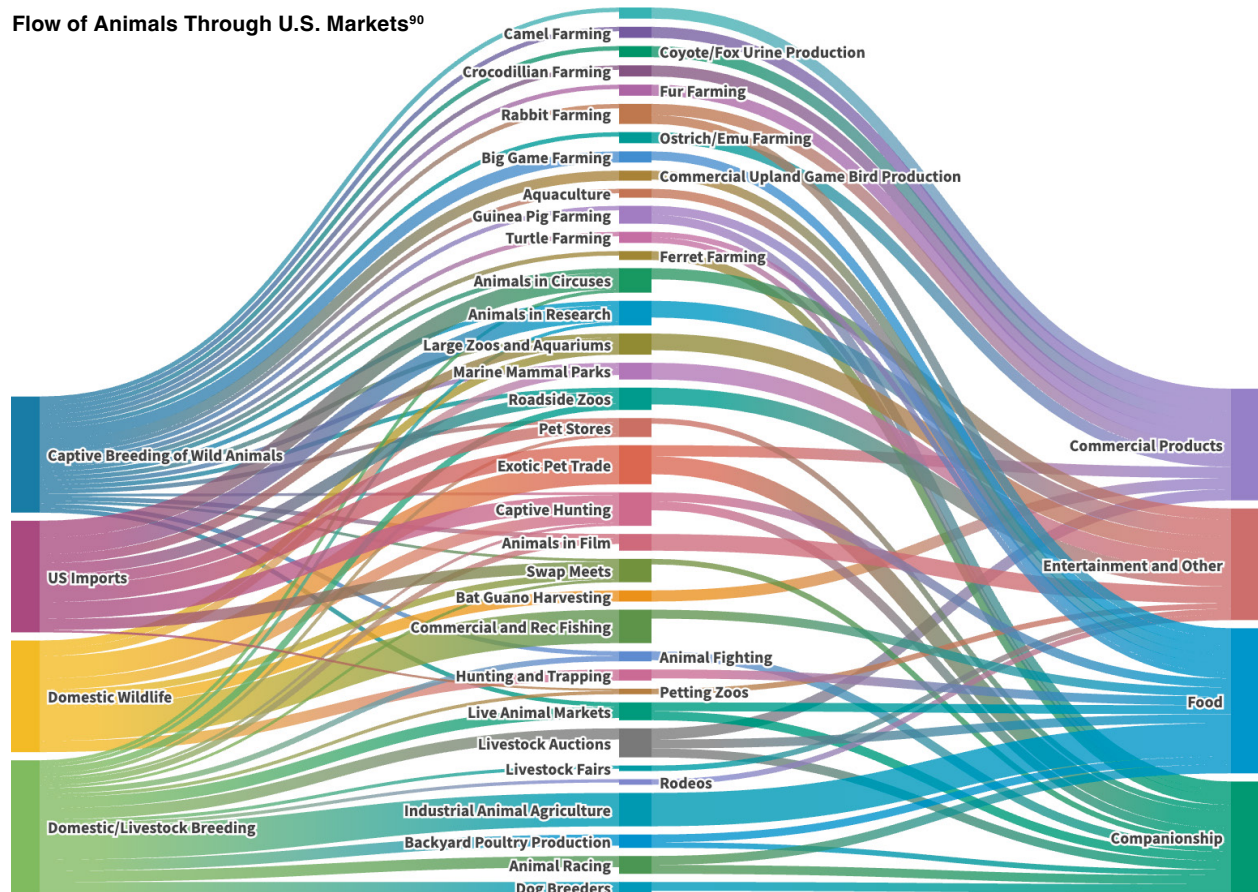


Jo-Anne McArthur / Eyes on Animals / We Animals Media

SOURCE MARKETS

Animals entering consumer-facing markets in the United States come from a limited but diverse set of sources. Within the United States, animals can be sourced from the wild or from breeding operations that produce wild or domestic animals.⁸⁹ Animals sourced internationally are imported both legally and illegally and may be bred in captivity, captured from the wild, or bred as livestock in their native countries. Many of the consumer-facing markets discussed below derive animals from more than one supply source. Similarly, many animals move through multiple markets, as they are used and then reused in different supply chains, coming into contact with other animals and other species along the way. The movement of animals carries with it the movement of pathogens. As such, the course of these journeys carries implications for the spread of zoonotic disease. Across each of these supply chains are human-animal touchpoints, where disease can spillover to humans.

89. A domestic animal is part of a species that has been born or bred for many generations to live alongside humans. Wild animals, regardless of whether they are born in captivity or in their natural habitats, remain genetically wild, even if they are tame enough to tolerate human presence.

Flow of Animals Through U.S. Markets⁹⁰

Animal Imports

Hundreds of million live animals enter the United States every year, each with the potential to introduce new or existing pathogens to local human, wildlife, and livestock populations.⁹¹ The United States is the number one importer of animals in the world, for both wildlife and livestock.^{92 93 94} About 224 million live wild animals and 883 million wildlife products worth over \$4.3 billion are legally brought into the United States annually, representing roughly 20% of the legal global wildlife market.^{95 96 97 98 99}

90. This graph illustrates the flow of animals from market sources through consumer-facing markets to end uses. This graph does not reflect relative sizes of market flows.
91. "Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases," *United States Government Accountability Office*, Report GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.
92. M. Shahbandeh, "Live Animals: Leading Importers Worldwide 2020, by Country," *Statista*, August 5, 2021, <https://www.statista.com/statistics/1043966/live-animals-leading-importers-worldwide/>.
93. Jia Huan Liew, Zi Yi Kho et al. "International Socioeconomic Inequality Drives Trade Patterns in the Global Wildlife Market," *Science Advances* 7, No. 19 (May 5, 2021): doi: 10.1126/sciadv.abf7679.
94. Rob Cook, "World Cattle Imports: Ranking Of Countries," *Beef2Live*, January 20, 2022, <https://beef2live.com/story-world-cattle-imports-ranking-countries-0-106724>.
95. K. M. Smith, C. Zambrana-Torrel, A. White, M. Asmussen, et al., "Summarizing US Wildlife Trade with an Eye Toward Assessing the Risk of Infectious Disease Introduction," *Ecohealth* 14, No. 1 (2017): 29-39, doi: 10.1007/s10393-017-1211-7.
96. "End Wildlife Trade: An Action Plan to Prevent Future Pandemics," *Center for Biological Diversity*, Natural Resources Defense Council, Inc., May 2020, <https://www.nrdc.org/sites/default/files/end-wildlife-trade-202005.pdf>.
97. "Law Enforcement at a Glance," *U.S. Fish and Wildlife Service*, last modified March 28, 2020, <https://www.documentcloud.org/documents/6843670-U-S-Fish-and-Wildlife-Service-Law-Enforcement-at.html>.
98. Tanya Sanerib and Sarah Uhlemann, "Dealing in Disease: How U.S. Wildlife Imports Fuel Global Pandemic Risks," *Center for Biological Diversity*, September 2020, https://www.researchgate.net/publication/344418548_Dealing_in_Disease_9-28-2020/.
99. Wildlife products can carry bacteria, such as *Francisella tularensis* which causes Tularemia or *Bacillus anthracis*, which causes Anthrax and was imported into the United State through contaminated bongo drums made from goatskin. Dead animals or animal parts can also be hosts to many different parasites such as mites, fleas or ticks, spreading other diseases like Lyme disease, typhus, and lice. "Animal Transmitted Diseases," Washington State Department of Health, accessed June 2, 2023, <https://doh.wa.gov/you-and-your-family/illness-and-disease-z/animal-transmitted-diseases>; "Risk from Exposure to Hides/Drums Contaminated with Anthrax," *Centers for Disease Control and Prevention*, last updated November 20, 2020, <https://www.cdc.gov/anthrax/animal-products/hides-drums.html>.

Four in five of these animals are captured from the wild, while the remaining fifth are sourced from captive breeding facilities overseas.¹⁰⁰ They may bring with them non-native diseases that pose a risk to humans, livestock, and native species.

One of the only resources available to track wildlife imports is the Law Enforcement Management Information System (LEMIS) database managed by the FWS.¹⁰¹ But since 2014, FWS has withheld much of the data, leaving many Freedom of Information Act requests unfulfilled.^{102 103} As a result, there is incomplete information available about what wild animals are entering the country and where these animals are coming from.

Animals entering the United States move through both legal and illegal channels. Though most wildlife imports are legally declared, there is a significant volume of trade that passes into the country illegally.¹⁰⁴ Some estimates place the magnitude of this illegal trade at over \$1.4 billion, just over a third of the size of the legal import market.¹⁰⁵ Wildlife trafficking encompasses a wide range of species from all continents, including exotic birds, sea turtles, coral, caimans, crocodiles, and primates. Between 2007 and 2017, nearly one in three wildlife seizures in the United States was made in El Paso, Texas.¹⁰⁶ Animals are hidden for illegal import in a variety of ways, including salamanders in plastic bags, tiger cubs in duffel bags, and addax antelope in horse trailers. Smuggling can also be carried out by hiding illegal animals among legal ones, forging permits, misusing real permits, or, on rare occasions, by bribing

There is incomplete information available about what wild animals are entering the country and where these animals are coming from.

100. E.A. Eskew, A.M. White, N. Ross et al. (2020). "United States Wildlife and Wildlife Product Imports from 2000–2014," *Sci Data* 7, No. 22 (2020) <https://doi.org/10.1038/s41597-020-0354-5>.
101. In many cases, the LEMIS data is our best and only source for information about what animals are coming into the country. The database provides insight into the scope and scale of the US wildlife trade, though it is not exhaustive. The LEMIS data contains basic information about wildlife imports, for example, descriptors such as quantity, port of entry, taxonomic class, import purpose, etc. much of which may be relevant to policymakers. Still, the LEMIS data is not without issues. For example, the data appears to drastically undercount the number of wildlife that die in transit, designating just .07% of wildlife as "dead on arrival." However, this figure appears inconsistent with most estimates and expert opinion. For many species, anywhere between 10-60% of animals are believed to die in transit before reaching their final destination. Uncertainty surrounding these estimates is compounded by the fact that the data does not indicate whether a shipment is considered "dead on arrival" if it contains any non-living animals or only when the *entire* shipment is found to have died. Finally, these metrics should be taken with a grain of salt as many if not most animals are cleared for import without being visually inspected by anyone. Without seeing the shipment, inspectors cannot provide accurate data in response to questions like this one. LEMIS data also offers incomplete information regarding the point of origin of wildlife imports, for example. Often suppliers designate point of origin to mean the most recent country the animal has passed through during shipment rather than the original source country where the animal is from. Other times, the origin location is made up entirely, where forms report impossible locations—source countries where the animal in question is not endemic, nor was the location listed a point of transit. These inconsistencies make tracing disease outbreaks and assessing risk more difficult. The dataset is limited in more profound ways as well (see additional discussion below). Evan Eskew, Allison White, Neom Ross, Kristine Smith, et al., "Data from: United States Wildlife and Wildlife Product Imports from 2000–2014." *Scientific Data* 7, No. 1 (2020): <https://doi.org/10.1038/s41597-020-0354-5>; Rachel Nuwer, "Many Exotic Pets Suffer or Die in Transit, and Beyond—and the U.S. government is Failing to Act" *National Geographic*, March 2, 2021, <https://www.nationalgeographic.com/animals/article/exotic-pets-suffer-wildlife-trade>; personal interview with former US FWS import inspector, June 10, 2021.
102. Only a small timespan of data, dating from 2001 to 2014, has been released to the public, and this was obtained by researchers and NGOs through Freedom of Information Act (FOIA) requests. However, in the years since, FWS has implemented a new policy to notify wildlife vendors when FOIAs are submitted and to allow them to withhold certain information on the basis that it contains "trade secrets." With that change, FWS has not kept up with FOIA requests and, at the time of this writing, is under suit for failing to release new LEMIS data. Having accurate information on wildlife imports into the United States is essential for effective surveillance and zoonotic risk mitigation. This information should be shared openly with both the public and with policy-makers to inform public health policy.
103. "Lawsuit Demands Crucial U.S. Wildlife Trade Data," *Harvard Law School's Animal Law & Policy Clinic*, November 17, 2021, <https://animal.law.harvard.edu/news-article/wildlife-trade-data/>.
104. Nigel South, Tanya Wyatt, "Comparing Illicit Trades in Wildlife and Drugs: An Exploratory Study," *Deviant Behavior* 32, No. 6 (2011): 538-561, doi:10.1080/01639625.2010.483162.
105. Jeremy Haken, "Transnational Crime In The Developing World," *Global Financial Integrity*, February 2011, https://secureservercdn.net/50.62.198.97/34n.8bd.myftpupload.com/wp-content/uploads/2014/05/gfi_transnational_crime_high-res.pdf.
106. Kevin Sieff, "Tape their beaks: Wildlife Trafficking Case Offers Glimpse into Clandestine Animal Trade from Mexico," *The Washington Post*, September 11, 2021, <https://www.washingtonpost.com/world/2021/09/11/us-mexico-wildlife-trafficking>.

customs and border officials.^{107 108 109} It is assumed that a significant portion of the illegal trade market into the United States is enabled by the Internet and related cyber technology. Once in the United States, it is common for smuggled wildlife to be shipped via FedEx or U.S. Postal Service to domestic customers.¹¹⁰

While the illegal trade smuggles protected species into the country for sale, in many cases the legal trade offers only nominally more oversight. An overwhelming majority of live wild animals are never physically inspected upon entering the country, nor are they quarantined. FWS has no legal authority to check wildlife imports for disease unless mandated to do so by another agency such as the CDC or the USDA.

The widespread lack of disease testing with respect to wildlife entering the country may come as a surprise to many Americans.



The widespread lack of disease testing with respect to wildlife entering the country may come as a surprise to many Americans because other public-facing aspects of the process appear to be better controlled. For example, a resident attempting to travel back to the United States with their companion animal may be required to go through veterinary checks and a 30-day quarantine period, while a commercial wholesaler importing hundreds of sugar gliders or other wild animals would not be subject to either process. Similarly, an individual cannot bring meat from abroad back to the United States, but one can import live wild animals from those same countries with very little scrutiny.¹¹¹

On the domestic side, each year the United States imports more than 22 million live farmed animals (including cattle, hogs, sheep, and chicken) and 3.6 billion pounds of meat and chicken.¹¹² ^{113 114} This large volume of imported farmed animals and related products helps feed the large demand for meat in the United States. Further, the United States exports some of the same animals it imports, making disease tracing even more complicated.

107. Peyton Ferrier, "The Economics of Agricultural and Wildlife Smuggling," *USDA Economic Research Service*, Report No. 81, September 2009, https://www.ers.usda.gov/webdocs/publications/46261/11019_err81_1_.pdf?v=0.

108. Personal interview with retired Ohio police officer and expert on exotic pets and large cats, May 18, 2021.

109. "Former USDA Animal Inspector Pleads Guilty," *U.S. Attorney's Office*, Southern District of Texas, last modified April 19, 2023, <https://www.justice.gov/usao-sdtx/pr/former-usda-animal-inspector-pleads-guilty>.

110. Kevin Sieff, "Tape their beaks: Wildlife Trafficking Case Offers Glimpse into Clandestine Animal Trade from Mexico" *The Washington Post*, September 11, 2021, <https://www.washingtonpost.com/world/2021/09/11/us-mexico-wildlife-trafficking/>.

111. "Trade in wild animals: a disaster ignored," *The Lancet Infectious Diseases* 3, No. 7 (July 1 2003):391, doi: [https://doi.org/10.1016/S1473-3099\(03\)00695-9](https://doi.org/10.1016/S1473-3099(03)00695-9).

112. "Livestock and Meat International Trade Data," *USDA Economic Research Service*, last modified April 6, 2023, <https://www.ers.usda.gov/data-products/livestock-and-meat-international-trade-data/>.

113. "Imports of Cattle and Beef Hit Historical High in 2020," *R-CALF USA*, February 11, 2021, <https://www.r-calfusa.com/imports-of-cattle-and-beef-hit-historical-high-in-2020/>.

114. Carys Bennett, "The Live Animal Trade In The U.S.: A Review," *Faunalytics*, September 13, 2018, <https://faunalytics.org/the-live-animal-trade-in-the-u-s-a-review/#>.

Disease surveillance of livestock imports is more robust than that of wildlife, in part because of the economic risks posed to domestic producers. The USDA mandates testing for a handful of diseases associated with outbreaks in the past, including foot-and-mouth disease, Newcastle disease, and avian influenza. Such testing, however, is carried out through random sampling of larger populations and generally applied only to livestock and poultry, though other species of imported wildlife may carry these same diseases.^{115 116}

Captive Breeding of Wild Animals

Thousands of species of native and non-native wild animals are captively bred in the United States, some of which are high-risk hosts for zoonotic diseases. Estimates suggest these animals number in the tens of millions.^{117 118}

Captivity concentrates animals of the same and different species in densities rarely found in nature, both making them susceptible to a wider range of diseases and, potentially, making them more likely to share these diseases with humans, exposing them at higher “doses.” These captive-bred animals serve a number of commercial uses including food, medicine, and other consumptive uses. They also satisfy demand from zoos and circuses, exotic pet stores, biomedical research institutions, and others. Yet, hundreds of these species fall outside the bounds of regulation as neither livestock nor free-roaming wildlife, exposing gaps in oversight.

Many captive-raised animals, such as mink, foxes, rabbits, guinea pigs, mice, coyotes, and turtles, are housed in large numbers in close confinement, enhancing the likelihood of disease spread.¹¹⁹ Genetic diversity, healthy immune systems, and space between animals, all of which act as a natural buffer to disease outbreaks, are typically lacking in captive breeding operations.^{120 121 122} This risk is sometimes compounded by interspecies contact as well as close contact with humans.¹²³ While some captive breeders focus exclusively on one species, many raise multiple types of domestic animals and wildlife, creating a mixing ground for interactions among species that would never occur in nature, and along with it, opportunities for the development of new and dangerous pathogens.

Thousands of species of native and non-native wild animals are captively bred in the United States, some of which are high-risk hosts for zoonotic diseases.

115. Particular species of wild animals, generally those regulated by the CDC, may undergo testing or quarantine. Wild birds, primates, and some species of ungulates, for example, who arrive in the United States may undergo quarantine procedures, for example. Boris I. Pavlin, Lisa M. Schloegel, and Peter Daszak, “Risk of Importing Zoonotic Diseases through Wildlife Trade, United States,” *Emerging Infectious Diseases* 15, No. 11 (November 1, 2009): 1721–27, <https://doi.org/10.3201/eid1511.090467>.

116. Nonhuman primates are regulated by the CDC as are an exception to this general rule. Imported nonhuman primates must also be quarantined upon arrival for 31 days during which three tuberculin skin tests at 2-week intervals are given and the incubation period for many known serious infectious zoonoses can pass. Jeffrey A. Roberts, Kirk Andrews, “Nonhuman Primate Quarantine: Its Evolution and Practice” *ILAR Journal* 49, No. 2 (2008): 145156, <https://doi.org/10.1093/ilar.49.2.145>.

117. David Grimm, “How many mice and rats are used in U.S. labs? Controversial study says more than 100 million,” *Science*, January 12, 2021, <https://www.sciencemag.org/news/2021/01/how-many-mice-and-rats-are-used-us-labs-controversial-study-says-more-100-million>.

118. “Captive Animals,” *Animal Legal Defense Fund*, accessed May 31, 2023, https://aldf.org/focus_area/captive-animals/.

119. Noel Snyder, Scott Derrickson et al., “Limitations of Captive Breeding in Endangered Species Recovery,” *Conservation Biology* 10, No. 2 (1996): 338–348, <https://doi.org/10.1046/j.1523-1739.1996.10020338.x>.

120. S.J. O’Brien and J.F. Evermann, “Interactive Influence of Infectious Disease and Genetic Diversity in Natural Populations,” *Trends in Ecology & Evolution* 3, No. 10 (1988): 254–259, [https://doi.org/10.1016/0169-5347\(88\)90058-4](https://doi.org/10.1016/0169-5347(88)90058-4).

121. The Humane Society of the United States, “An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza,” *Impact of Animal Agriculture* 9 (2007), https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.

122. For instance, in 2016 California implemented the Orca Protection Act which bans holding orcas in captivity for performance or entertainment purposes in California and ends captive breeding programs and the import/export of orcas and their genetic material into/out of the state. “Cetacean Anti-Captivity Legislation and Laws,” *Animal Welfare Institute*, accessed May 20, 2022, <https://awionline.org/content/cetacean-anti-captivity-legislation>.

123. Joel Henrique Ellwangerand José Artur Bogo Chies, “Zoonotic Spillover: Understanding Basic Aspects for Better Prevention,” *Genetics and Molecular Biology* 44, No. 1 Supp 1 (2021): doi: 10.1590/1678-4685-GMB-2020-0355.

Some large wholesale dealers keep tens of thousands of animals together at a single site, often in close confinement and with little veterinary care. A study of one such wholesaler warehouse in Texas documented more than 26,400 animals of 171 species, including 30 invertebrates, 39 amphibians, 78 reptiles, and 24 mammals.¹²⁴ Some 80% of the animals were sick, injured, or dead—with average losses of 872 animals per day.¹²⁵ ¹²⁶ These operations, which sometimes both breed animals and import others from abroad, allow pathogens to spread between species, while signs of disease may go unnoticed given the high rates of turnover.



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Captive breeding programs also have the potential to introduce disease to native wildlife. For example, a wild mink, living near a Utah fur farm, tested positive for COVID-19, suggesting transmission from captive mink to wildlife, a pathway that could allow the disease to spread uncontrollably through wild populations and risk creating new permanent reservoirs of the disease in nature.¹²⁷ The same can be true of transmission from captive wild animals to livestock. Many captive breeding operations also produce other animals—for example, close to 70% of bison farms produce additional livestock such as cattle.¹²⁸ Captive wild animals can spread disease to cohabitating livestock, as well as dogs, cats, and other companion animals. Yet, despite these risks, captive breeding operations enjoy scant regulatory oversight.

Wildlife

There are close to 3,000 native species of wildlife in the United States, occupying both private and public lands. Among them are 428 species of mammals and 784 bird species ranging from American bison to golden-cheeked warblers.¹²⁹ In addition to these 3,000 native species, USGS estimates that there are an additional 6,767 invasive species living across the United States that were brought into the country from elsewhere and released—either accidentally or intentionally—by humans.¹³⁰ These

124. Shawn Ashley 1, Susan Brown, Joel Ledford, Janet Martin, et al., “Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler,” *J Appl Anim Welf Sci* 17, No. 4 (2014): 308-21, doi: 10.1080/10888705.2014.918511.
125. An estimated 3,500 reptiles were discarded weekly (a mortality rate of 72%) along with 2,600 other animals including prairie dogs, sloths, and small rodents, though many of these deaths were not recorded. The study found that the deaths and sickness of the animals were the result of disease and other causes attributable to poor conditions: including cannibalism, crushing, dehydration, emaciation, hypothermic stress, infestation, starvation, overcrowding, stress, and other injuries. The dealer had no disease testing protocols in place before animals were shipped to consumers. Shawn Ashley 1, Susan Brown, Joel Ledford, Janet Martin, et al., “Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler,” *J Appl Anim Welf Sci* 17, No. 4 (2014): 308-21, doi: 10.1080/10888705.2014.918511.
126. Shawn Ashley 1, Susan Brown, Joel Ledford, Janet Martin, et al., “Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler,” *J Appl Anim Welf Sci* 17, No. 4 (2014): 308-21, doi: 10.1080/10888705.2014.918511.
127. Christa Leste-Lasserre, “Mutant Coronaviruses Found in Mink Spark Massive Culls and Doom a Danish Group’s Research,” *Science* (November 11, 2020), <https://www.science.org/content/article/mutant-coronaviruses-found-mink-spark-massive-culls-and-doom-danish-group-s-research>.
128. “Bison 2014: Health and Management Practices on U.S. Ranches—Bison Operations,” *USDA*, December 2016, https://www.aphis.usda.gov/animal_health/nahms/bison/downloads/bison14/Bison2014_DR.pdf.
129. Liz Osborn, “Number of Native Species in the United States,” *Current Results*, last accessed May 19, 2022, <https://www.currentresults.com/Environment-Facts/Plants-Animals/number-of-native-species-in-united-states.php>.
130. Annie Simpson and Meghan Eyster, “First Comprehensive List of Non-Native Species Established in Three Major Regions of the United States: U.S. Geological Survey Open-File Report 2018-1156,” *USGS* (November 6, 2018): <https://doi.org/10.3133/ofr20181156>.



invasive species include ring-necked pheasants, burmese pythons, and feral swine. Many of these animals, which have taken hold in native ecosystems, were brought to the United States in service of the markets discussed in this report and used in hunting, farming, entertainment, or to be kept as pets. The presence of invasive species can undermine ecosystem health, degrading biodiversity, and in the process, allowing new and existing diseases a stronger foothold in the United States.¹³¹

Of the 2.27 billion acres of land in the United States, roughly 40% is publicly owned, divided between state and federal lands.¹³² While federal legislation protects a handful of endangered or threatened species, the vast majority of wildlife regulation occurs at the state level. Wildlife in the United States generally is held under the public trust doctrine, meaning it belongs to the government and the people, rather than private landowners. Hunting on public lands happens under licensing systems at the state level that regulate a number of hunting criteria, often including seasons, species, and quotas as well as what weapons or traps may be used. Private hunting preserves are also licensed by the state and typically charge a fee to hunt on private property.¹³³

Livestock and Other Domestic Animal Production

Domestic animal and livestock breeding includes both small breeding operations, such as backyard breeders of birds and dogs, all the way up to large, concentrated animal feeding operations that produce millions of chickens, pigs, and cattle (referred to as “CAFOs”, the acronym for Concentrated Animal Feeding Operations, which are also colloquially called “factory farms”). Roughly 98% of livestock bred in the United States move through large-scale industrialized systems of production.^{134 135} These operations have become a ubiquitous part of the American landscape and food system.^{136 137 138} Facilities can stretch more than a mile long and contain millions of animals, some with populations larger than the City of Los Angeles.¹³⁹

Facilities can stretch more than a mile long and contain millions of animals, some with populations larger than the City of Los Angeles.

131. M. Everard, P. Johnston, D. Santillo, and C. Staddon, “The Role of Ecosystems in Mitigation and Management of Covid-19 and Other Zoonoses,” *Environmental Science & Policy* 111, (2020): 7–17, <https://doi.org/10.1016/j.envsci.2020.05.017>.
132. Roughly 70% of public land is owned by the states, while the remaining 30% is managed by the federal government. Public lands are concentrated in the Western United States and in particular, Alaska. Carol Hardy Vincent, Laura A. Hanson, and Laura A. Hanson, “Federal Land Ownership: Overview and Data,” *Congressional Research Service*, last modified February 21, 2020, <https://sgp.fas.org/crs/misc/R42346.pdf>.
133. States have primary legal responsibility for wildlife protection and administration. National Research Council (US) Committee on Agricultural Land Use and Wildlife Resources. *Land Use and Wildlife Resources*. (Washington DC: National Academies Press, 1970), Chapter 8, Legislation and Administration, <https://www.ncbi.nlm.nih.gov/books/NBK208748/>.
134. CAFOs are regulated under the National Pollutant Discharge Elimination System (NPDES) of the EPA. “Animal Feeding Operations (AFOs),” *United States Environmental Protection Agency*, last updated February 16, 2023, <https://www.epa.gov/npdes/animal-feeding-operations-afos>.
135. Lindsay Walton and Kristen King Jaiven, “Reeregulating CAFOs For the Well-Being of Farm Animals, Consumers, and the Environment,” *Environmental Law Reporter* 50 ELR 10485, June 2020, <https://www.elr.info/sites/default/files/article/2020/05/50.10485.pdf>.
136. Matthew Zampa, “99% of U.S. Farmed Animals Live on Factory Farms,” *Sentient Media*, April 16, 2019, 2021 <https://sentientmedia.org/u-s-farmed-animals-live-on-factory-farms/>.
137. Zack Hrynowski, “What Percentage of Americans Are Vegetarian?” *Gallup*, accessed May 31, 2023, <https://news.gallup.com/poll/267074/percentage-americans-vegetarian.aspx>.
138. Caroline Christen, “Meat Consumption in the U.S. Is Growing at an Alarming Rate,” *Sentient Media*, March 17, 2021, <https://sentientmedia.org/meat-consumption-in-the-us/>.
139. Denis Hayes and Gail Boyer Hayes, Cowed: *The Hidden Impact of 93 Million Cows on America’s Health, Economy, Politics, Culture, and Environment*, (New York: W. W. Norton & Company, 2015).

There are over 21,000 CAFOs in the United States, with another 450,000 smaller but similar operations.^{140 141 142} Chickens, pigs, and cattle are the primary species raised in these facilities. In aggregate, American CAFOs produce over 9.4 billion chickens, 125 million pigs, 380 million laying hens, and close to 40 million beef and milking cows each year.^{143 144 145 146} Tyson Foods, the largest chicken processor in the United States, slaughters an average of 35 million chickens per week, while the Cargill meatpacking plant in Dodge City, Kansas slaughters over 5,800 cows, producing two million pounds of meat per day.^{147 148} Industrial animal agriculture in the United States is highly concentrated in the hands of a few corporations, who wield enormous financial power. Tyson Foods, Cargill, JBS S.A., and Smithfield Foods collectively control over 80% of cow slaughtering and processing in the United States.¹⁴⁹ JBS and Smithfield together control 63% of pig slaughtering and processing, while a similar few companies produce over 60% of American poultry products.¹⁵⁰

In addition to industrial animal agriculture, backyard poultry operations have become more popular in the United States in recent decades. These operations range from a couple of birds up to flocks of a thousand, and they often contain a variety of species such as chickens, ducks, geese, peafowl (peacocks), guinea fowl, and turkeys. Some companion animals, such as dogs and cats, are also produced by backyard breeders, while others are raised in facilities that more closely resemble factory farms.¹⁵¹



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140. "Animal Feeding Operations," *USDA NRCS*, accessed May 3, 2023, <https://www.nrcs.usda.gov/getting-assistance/other-topics/nutrient-management>.
141. This number is based on the restrictive definition set forth by the Environmental Protection Agency. "Animal Feeding Operations (AFOs)," *United States Environmental Protection Agency*, last updated February 16, 2023, <https://www.epa.gov/npdes/animal-feeding-operations-afos>.
142. Christopher Walljasper, "Large animal feeding operations on the rise," *MidWest Center for Investigative Reporting*, June 7, 2018, <https://investigatamidwest.org/2018/06/07/large-animal-feeding-operations-on-the-rise/>.
143. "Broiler Chicken Industry Key Facts 2021," *National Chicken Council*, accessed May 31, 2023, <https://www.nationalchickencouncil.org/about-the-industry/statistics/broiler-chicken-industry-key-facts/>.
144. Chris McGreal, "How America's Food Giants Swallowed the Family Farms," *The Guardian*, March 9, 2019, <https://www.theguardian.com/environment/2019/mar/09/american-food-giants-swallow-the-family-farms-iowa>.
145. M. Shahbandeh, "Total Number of Laying Hens in the U.S. 2000-2020," *Statista*, March 25, 2022, from <https://www.statista.com/statistics/195823/total-number-of-laying-hens-in-the-us-since-2000/>.
146. M. Shahbandeh, "Number of Beef and Milk Cows in the United States from 2001 to 2019," *Statista*, January 28, 2022, <https://www.statista.com/statistics/194302/number-of-beef-and-milk-cows-in-the-us/>.
147. Matthew Zampa, "99% of U.S. Farmed Animals Live on Factory Farms," *Sentient Media*, April 16, 2019, <https://sentientmedia.org/u-s-farmed-animals-live-on-factory-farms/>.
148. Michael Holtz, "6 Months Inside One of America's Most Dangerous Industries," *The Atlantic*, June 14, 2021, <https://www.theatlantic.com/magazine/archive/2021/07/meatpacking-plant-dodge-city/619011/>.
149. Jonathan Stempel, "Lawsuit Says Tyson, Cargill, JBS Conspired to Suppress Beef Prices Paid to U.S. Ranchers," *Reuters*, April 23, 2019, <https://www.reuters.com/article/us-cattle-lawsuit/lawsuit-says-tyson-cargill-jbs-conspired-to-suppress-beef-prices-paid-to-u-s-ranchers-idUSKCN1RZ2AO>.
150. Animal Legal Defense Fund et al., "Before the United States Department of Agriculture: Petition for Emergency Rulemaking," August 25, 2020, https://www.biologicaldiversity.org/programs/environmental_health/pdfs/2020-08-25--Emergency-Rulemaking-Petition-to-USDA_Factory-Farm-Depopulation.pdf.
151. Over 2.4 million puppies are bred annually in the United States in large commercial facilities as well as smaller backyard operations. Jack Curran, "Industry Report OD4643: Dog and Pet Breeders," *IBISWorld*, December 2019.

Livestock operations of all sizes contribute to the nation's risk of zoonotic outbreaks. While small-scale producers may offer animals better welfare and more space, they often have lower biosecurity and amplify risk by aggregating multiple species at the same location. By contrast, industrial animal agriculture, which focuses on a single species, may have higher biosecurity, but presents a much larger risk in terms of both scale of production and the production practices employed, putting workers and surrounding communities at risk.¹⁵²

The animals themselves are not the only source of disease risk. Safe management and disposal of animal carcasses and animal waste has proved challenging as both processes can spread pathogens. For example, in North Carolina, the state's 9 million swine produce over 62 million pounds of manure each day and 10 billion gallons of waste each year.^{153 154} A single swine facility can produce more sewage than all but a small handful of the largest cities in the United States.¹⁵⁵

CAFOs heighten the risk of zoonotic disease in other ways as well. Overuse of antibiotics, which are fed prophylactically to livestock, drives the development of antibiotic resistant strains of bacteria and renders these same medicines ineffective for treating disease in humans.¹⁵⁶ Roughly 70% of medically important antibiotics used in the United States are fed to livestock.¹⁵⁷ In addition, animal agriculture reduces biodiversity and contributes substantially to climate change, which may serve as a threat multiplier for zoonotic outbreaks.^{158 159 160}

152. Native populations have a long and tragic history with infectious disease, in part as a result of new exposures to livestock. When Europeans traveled to the Americas during colonization, the mixing came with devastating results. Some estimate that more than 70% of indigenous people perished from disease following sustained European contact. One reason why Europeans proved to carry so many more pathogens than native people is because of their extensive history of close contact with livestock. Diseases that had spread through livestock production in Europe were brought to native populations with no such history or immunity against these zoonotic diseases. Simon L. Lewis and Mark A. Maslin, "How Disease and Conquest Carved a New Planetary Landscape," *The Atlantic*, August 24, 2018, <https://www.theatlantic.com/science/archive/2018/08/human-planet-migration-columbian-exchange/568423/>.
153. Michael Sainato and Chelsea Skojec, "The North Carolina Hog Industry's Answer to Pollution: a \$500m Pipeline Project," *The Guardian*, December 11, 2020, <https://www.theguardian.com/us-news/2020/dec/11/north-carolina-hog-industry-lagoons-pipeline>.
154. Kendra Pierre-Louis, "Lagoons of Pig Waste Are Overflowing After Florence. Yes, That's as Nasty as It Sounds," *The New York Times*, September 19, 2018, <https://www.nytimes.com/2018/09/19/climate/florence-hog-farms.html>.
155. Carrie Hribar, "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities," *National Association of Local Boards of Health*, 2010, https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf, accessed May 3, 2023.
156. "Antimicrobial Resistance," *US Food and Drug Administration*, last updated April 28, 2023, <https://www.fda.gov/animal-veterinary/safety-health/antimicrobial-resistance>.
157. Many antibiotics are fed prophylactically to livestock, though since 2017, when the FDA's "Guidance for Industry #213" went into effect, they can no longer be used purely as growth stimulants. "Antibiotics and Animal Agriculture: A Primer," *Pew Charitable Trusts*, December 19, 2016, <https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2016/12/antibiotics-and-animal-agriculture-a-primer>.
158. There are many reasons for this. For example, as a changing climate alters the landscape and natural systems, many species will become displaced and be forced to live in closer proximity to humans. Climate change drives new interactions, between different species of animals and between humans and animals, that can give rise to new outbreaks of disease. Some estimate that in the coming decades there will be up to 300,000 first encounters between species that normally do not interact, leading to about 15,000 spillover events where viruses enter new species. Ed Yong, "We Created the 'Pandemicene'" *The Atlantic*, April 28, 2022, <https://www.theatlantic.com/science/archive/2022/04/how-climate-change-impacts-pandemics/629699/>.
159. M. Everard, P. Johnston, D. Santillo, D., and C. Staddon, C., "The Role of Ecosystems in Mitigation and Management of Covid-19 and Other Zoonoses." *Environmental Science & Policy* 111, (September 2020): 7–17, <https://doi.org/10.1016/j.envsci.2020.05.017>.
160. "Biodiversity and Infectious Disease Questions and Answers," *The World Health Organization*, accessed May 31, 2023 https://www.who.int/docs/default-source/climate-change/qa-infectiousdiseases-who.pdf?sfvrsn=3a624917_3.

Significant government resources are dedicated to protecting agricultural animals from zoonotic disease because of their economic value and importance to the food supply. Much of this effort is carried out by the USDA as well as state departments of agriculture.¹⁶¹ The U.S. livestock industry is regulated primarily at and following the point of slaughter. There is very little regulation of livestock animals before they reach the slaughterhouse including the ways in which producers and livestock interact, leaving open significant opportunities for zoonotic spillover.



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161. "USDA 'One-Health' Approach: Fact Sheet," *USDA*, June 2016, <https://www.usda.gov/sites/default/files/documents/fact-sheet-one-health-06-16-2016.pdf>.



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CONSUMER MARKETS

In the following discussion, we examine 36 distinct consumer-facing animal markets, each with its own unique risk profile. This section of the report documents a range of U.S. animal markets—articulating the supply chains that support them, the regulation surrounding them, and evaluating the zoonotic risks that each may pose.

Zoonotic risk depends on a host of variables, many of which are difficult to measure. The market's operations, supply chain, and oversight each shape the level of inherent risk and the level of risk mitigation. We define inherent risks to include those derived from the nature of the activities themselves, derived from factors such as the types of species involved, the number of animals housed together, the level of confinement, the health of the animals, the types of pathogens they may carry, the intensity of human exposure to animals, the length of the supply chains and methods of transport, as well as the scale of the industry in question. Risk mitigation, on the other hand, is determined by the guardrails put in place to prevent disease transmission. It is a function of factors such as preventative biosecurity measures, transparency and traceability of supply chains, as well as the level of regulatory oversight.

These variables and others affect the likelihood, severity, and scale of a potential zoonotic outbreak. For example, the danger of the pathogens that a particular species may carry shapes the zoonotic risks posed by commercializing that animal. Single-strand RNA viruses are often considered to be the most dangerous pathogens because of their so-called pandemic potential, driven by their dangerously high mutation rate.¹⁶² This group includes influenza viruses (such as H1N1 and H5N1), coronaviruses (such as SARS-CoV-1, SARS-CoV-2, and MERS-CoV), retroviruses (such as HIV-1), filoviruses (such as Ebola), paramyxoviruses (such as Nipah virus and measles), and flaviviruses (such as Zika and West Nile). Of these, epidemiologists are perhaps the most concerned about influenzas, which can mutate rapidly and carry fatality rates of up to 60%, though historically the mortality rate of dominant strains has been substantially lower.^{163 164}

Single-strand RNA viruses are often considered to be the most dangerous pathogens because of their so-called pandemic potential, driven by their dangerously high mutation rate.

Pathogens of High Priority

	Influenza Viruses	Coronaviruses	Retroviruses	Paramyxoviruses	Flaviviruses	Filoviruses	Lyssaviruses	Salmonella Bacteria	Brucella Bacteria
Primary Animal Carriers	Ducks. Wild Birds. Poultry. Pigs. Dogs. Horses. Seals. Others.	Non-Human Primates. Deer. Sheep. Mink. Ferrets. Camels.	Non-Human Primates. Cats.	Horses. Pigs. Dogs. Cats. Bats.	Deer. Rodents. Birds. Reptiles.	NH Primates. Bats. Cows. Horses. Pigs.	Cows. Horses. Raccoons. Skunks. Foxes. Cats. Dogs. Ferrets. Bats.	Poultry. Ruminants. Pigs. Horses. Rodents. Reptiles.	Cattle. Sheep. Antelopes. Deer. Giraffes. Bison. Elk. Pigs.
Captive Hunting	X	X		X	X				X
Exotic Pet Trade	X	X	X		X	X		X	X
Fur Farming		X					X		
Hunting and Trapping	X	X			X		X		X
Industrial Animal Ag	X			X	X	X	X	X	X
Live Animal Markets	X				X			X	
Livestock Auctions	X	X		X			X	X	X
Pet Stores	X		X	X	X		X	X	
Roadside Zoos	X	X		X				X	X
Backyard Poultry Production	X				X			X	
Swap Meets	X	X		X	X		X	X	

162. To code and prioritize these pathogens we relied on information gathered from interviews, research, and a multi-agency collaborative report published in 2017 by HHS, CDC, DOI, and USDA which ranks pathogens by risk. See Department of Health and Human Services, *Centers for Disease Control and Prevention*, US Department of Interior, USDA, “Prioritizing Zoonotic Diseases for Multisectoral, One Health Collaboration in the United States,” One Health Zoonotic Disease Prioritization Workshop Report, United States, December 5-7, 2017, <https://www.cdc.gov/onehealth/pdfs/us-ohzdp-report-508.pdf>.

163. Ali Khan and William Patrick, *The Next Pandemic: On the Front Lines Against Humankind’s Gravest Dangers*, (New York: Perseus Books, 2016), chap. 6, Apple Books.

164. Andrew Jacobs, “Avian Flu Spread in the U.S. Worries Poultry Industry,” *The New York Times*, February 24, 2022, <https://www.nytimes.com/2022/02/24/science/avian-flu-us-poultry.html>.

Risk Factors

For the Market Risks chart on the next page, we sought to evaluate the level of risk presented by conditions of each market based on research, interviews, and expert opinion. The chart maps 10 primary risk factors onto each of the markets examined in this report, which are organized here by general use categories. Note, however, that this set of risk factors is not exhaustive, nor is assessing risk a precise science. Each of the markets presented here is examined in greater detail in the pages that follow. Below are descriptions of how we evaluated the 10 primary risk factors used in the market risk grids displayed below and throughout the report.

Pathogen Danger: How dangerous are the types of pathogens that might be present in the market given the species of animals they contain? Certain species of animals are known to harbor certain types of pathogens. The danger posed by a pathogen is a reflection of its virulence but also its “pandemic potential,” which reflects how likely the pathogen is to become highly transmissible and spread human-to-human on a large scale. Of greatest concern for pandemic risk are single-strand RNA viruses, such as coronaviruses and influenza viruses, which are infamous for their ability to spread and change rapidly to generate new forms.

Intensity of Confinement: How closely confined are animals housed in the market? Are they densely packed together with many others? Housing a large number of animals in a small space enables pathogens to transmit more effectively between the animals, while allowing more space between animals does the opposite. Close confinement also creates stress for the animals which can make them more susceptible to disease.

Animal Health: How healthy and well maintained are animals in the market? Do they receive adequate veterinary care? Animals who have poor health and welfare are more susceptible to disease.

Mixing of Species: How many species of animals are contained in the market? As different types of animal species interact, it presents additional opportunities for pathogens to spread between species. This can lead to the development of new forms of the pathogen or allow it additional opportunities to spill over into humans.

Supply Chain: How long is the supply chain that animals move through? What kinds of conditions are maintained during transport? Transporting animals many times across long distances over lengthy periods of time can increase opportunities for disease exposure and transmission, as can aggregating animals from multiple different sources.

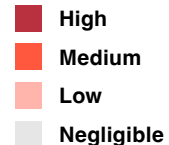
Biosecurity: What measures are taken or not taken to reduce the likelihood of introducing new pathogens or allowing existing pathogens to spread between animals or between humans and animals? Biosecurity measures might include cleaning and sterilizing animal enclosures, wearing personal protective equipment, or quarantining new animals before they are introduced.

Human Exposure: How frequently and intensely do humans and animals interact in the market? Certain activities, such as slaughtering an animal or hand-feeding an animal, are more likely to expose humans to pathogens than other less intensive interactions, such as watching wildlife from a distance, where there is no direct contact between humans and animals. In addition, the magnitude of human exposure can increase where more humans interact with more animals, such as at an industrial farm that may contain tens of thousands of animals and dozens of workers together at a single site.

Transparency: Does the industry maintain visibility, transparency, and good records of operations? Is the industry open to the public and regulators? Are they clear and forthcoming about their practices? Greater transparency can provide additional layers of oversight that might reduce the use of dangerous practices and make it easier to trace the origins of a disease outbreak in order to contain its spread.

Regulatory Oversight: How effectively is the market regulated? Are there regulations in place to mitigate disease risk, and, if so, how well are these regulations enforced? Additional health and safety checks can reduce the danger of zoonotic spillover and better manage disease risk.

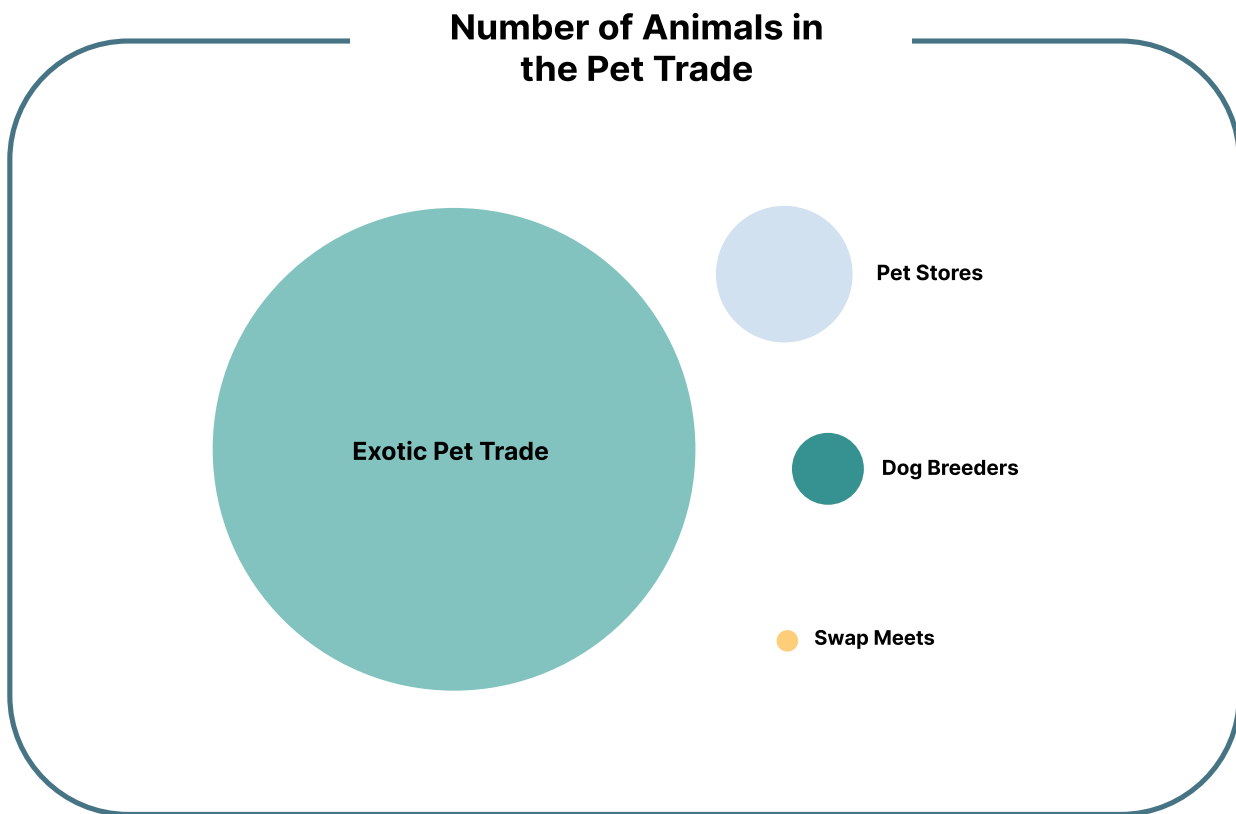
Market Size: How many animals are included in the market? Some markets are relatively small in scale, while others contain billions of animals. Greater numbers of animals (and human-animal interactions) means more opportunities for zoonotic transmission. The number of animals also affects the scale of any potential outbreak.





The Pet Trade

The pet trade includes a range of markets, each selling animals who are predominantly acquired for the purposes of living in or around the home as pets.¹⁶⁵ Markets within this industry offer a wide variety of animal species, from traditional companion animals such as dogs and cats to exotic pets such as Burmese pythons and tiger cubs. Studies show that the largest proportion of wildlife from high-risk taxa brought into the United States are imported for commercial use, in particular, for the exotic pet trade.¹⁶⁶ We divide the Pet Trade discussion into four consumer-facing markets: the exotic pet trade, pet stores, swap meets, and dog breeders, though in many cases their supply chains intermingle and overlap.¹⁶⁷



- Exotic Pet Trade, 113 million animals
- Pet Stores, 8.7 million animals
- Dog Breeders, 2.4 million animals
- Swap Meets, 200,000 animals

165. Our estimates for each of the market sizes as illustrated at the beginning of each market group are based upon government agency reports and/or publicly available data from industry associations. Where exact figures were not available, we extrapolated numbers based upon relevant available information, such as, but not limited to, average operation sizes, average number of animals per operation, or average weight of relevant species in the market. Market size charts are not to scale from one market group to the next.

166. Boris Pavlin, Lisa Schloegel, and Peter Daszak, "Risk of Importing Zoonotic Diseases through Wildlife Trade, United States." *Emerging Infectious Diseases* 15, No. 11 (Nov. 15, 2009) 1721–1726, doi: 10.3201/eid1511.090467.

167. For example, a pet store may sell dogs which come from dog breeders or kittens born in a local home, and a swap meet may sell animals imported through the exotic pet trade.

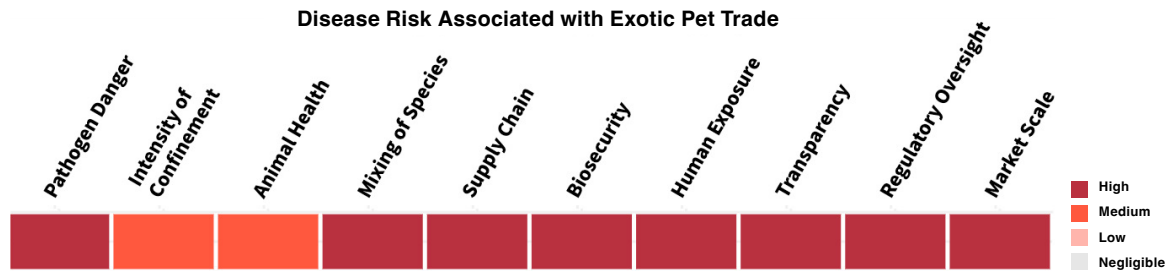
1. Exotic Pet Trade

The United States is a dominant driver of the pet trade globally.¹⁶⁸ Within the United States, the exotic pet trade includes hundreds of species and constitutes a large retail market, estimated to be worth as much as \$15 billion annually.¹⁶⁹ Roughly 14% of American households own one or more exotic animals, a category loosely defined to include any pet that is not a traditional companion animal (such as cats, dogs, or horses). These animals include species from lion cubs to monkeys, reptiles to tropical fish, and backyard fowl to exotic birds. Interest in exotic pets accelerated noticeably in the 1990s with the advent of reality TV shows such as Animal Planet's "The Crocodile Hunter," as well as popular live shows such as Siegfried and Roy.¹⁷⁰ The exotic pet industry has continued to grow, spurred on by digital demand—in particular the growth of e-commerce sites, social media, and other entertainment platforms, many of which serve not only as a forum to display exotic animals but also as a venue to advertise their sale and connect with potential customers.¹⁷² The American exotic pet trade sources animals legally and illegally from the wild as well as from captive breeding facilities all over the world.¹⁷⁵

Within the United States, the exotic pet trade includes hundreds of species and constitutes a large retail market, estimated to be worth as much as \$15 billion annually.



168. James S Sinclair, Oliver C Stringham, Bradley Udell, and Nicholas E Mandrak, "The International Vertebrate Pet Trade Network and Insights from US Imports of Exotic Pets," *Bioscience* 71, No. 9 (September 2021): 977–990, doi: 10.1093/biosci/biab056.
169. Estimating the value of the exotic pet trade in the United States is very hard due to widespread lack of tracking. Jessica Kim, "How Big Is the Exotic Pet Trade?" *PetKeen*, last updated May 13, 2023.
170. Through their career, the duo performed over 30,000 shows for over 50 million viewers. This ended abruptly in 2003 when Roy was attacked and nearly killed on stage by one of his white tigers. Alexi Duggins, "It Took Four Men and a Fire Extinguisher to Get the Tiger Off Him: the Tragedy of Vegas Magicians Siegfried and Roy," *The Guardian*, January 17, 2022, <https://www.theguardian.com/tv-and-radio/2022/jan/17/vegas-siegfried-roy-tiger-wild-things-mystery-exotic-animal-sin-city-counter-terrorism>.
171. For a closer examination between animal entertainment and demand for exotic pets, see *The Conservation Game*, directed by Michael Webber (Nightfly Entertainment, 2021), <https://www.theconservationgame.com/watch/>.
172. Jani Hall, "Exotic Pet Trade, Explained" *National Geographic*, Feb. 20, 2019, <https://www.nationalgeographic.com/animals/article/exotic-pet-trade>.
173. "Tiger King: Murder, Mayhem and Madness," Limited Series, *Netflix*.
174. Georgia Moloney, Jonathan Tuke, Eleonora Dal Grande, Torben Nielsen, Anne-Lise Chaber, "Is YouTube Promoting the Exotic Pet Trade? Analysis of the Global Public Perception of Popular YouTube Videos Featuring Threatened Exotic Animals," *PLoS ONE* 16 (4): e0235451 (2021), <https://doi.org/10.1371/journal.pone.0235451>.
175. "Ownership and or Possession and Appropriate Disposition of Wild and Exotic Pet Species or Their Hybrids," *American Veterinary Medical Association*, accessed May 31, 2023, <https://www.avma.org/resources-tools/avma-policies/ownership-and-or-possession-and-appropriate-disposition-wild-and-exotic-pet-species-or>.
176. Globally, the exotic pet trade is the number one driver of trade in live wildlife, with a large percentage of these animals being sourced directly from the wild. Lauren Harrington, et al., "Live Wild Animal Exports to Supply the Exotic Pet Trade: A Case Study from Togo Using Publicly Available Social Media Data," *Conservation Science and Practice* 3, No. 7 (July 2021): <https://doi.org/10.1111/csp2.430>.



The illegal wildlife plays a key role in the sourcing of many types of animals in the exotic pet trade; the annual value of the illegal trade of exotic pets in the United States is estimated at \$4.3 billion dollars.^{177 178} Illegal trafficking operates under the radar but sometimes occurs in plain sight, for example, moving a sedated tiger cub across the border in a duffel bag or selling one in the parking lot of a large department store.^{179 180} The illegal pet trade is diffuse and difficult to police but involves many of the same individuals who participate in the legal trade.¹⁸¹

On the legal side, breeders—whether larger commercial wholesalers, individual hobbyists, or something in between—supply millions of animals for sale in the United States each year. Some sell directly to consumers through digital sales, auctions, or trade shows, while others sell to pet stores or dealers.

Many commercial wholesalers operate with minimal health standards. For example, a 2014 study examining a large international exotic animal wholesaler in Texas found that 80% of the more than 25,000 animals held at the facility were either injured, sick, or dead from disease and other causes attributable to poor conditions.¹⁸² These animals, representing more than 170 species including sloths, snakes, prairie dogs, frogs, and exotic rodents, suffered extremely high mortality rates. An estimated 6,100 individual animals died and were discarded each week on average, though many of these deaths were not recorded.¹⁸³ The dealership had no disease testing protocols in place nor did they seek to establish the cause of death when animals died to identify potential disease outbreaks. Quarantine protocols at the dealership were also inconsistent, though many animals were brought in from abroad and captured from the wild while others were shipped out from the facility to dealers and consumers across the country.¹⁸⁴

Zoos also can play a role in facilitating the exotic pet trade. When the young animals grow and no longer attract visitors for photo opportunities and the like, they sometimes are sold into the pet trade,

177. Jia Hao To, William S. Symes, and Luis Roman Carrasco, "Economic Value of Illegal Wildlife Trade Entering the US," *PLoS ONE* 16, No. 10, e0258523, <https://doi.org/10.1371/journal.pone.0258523>.

178. Asia Siev, "Detailed Discussion of the Exotic Pet Trade," *Animal Legal & Historical Center* (2022): <https://www.animallaw.info/article/detailed-discussion-exotic-pet-trade>.

179. "Tiger Found in Duffel Bag Being Smuggled Across U.S.-Mexico Border," *CBS News*, May 2, 2018, <https://www.youtube.com/watch?v=WVMvujP0DfY>.

180. "Police: Woman Tries to Sell Tigers Outside Wal-M," *Associated Press*, June 16, 2008, <https://www.youtube.com/watch?v=OmkF6gJz-JY>.

181. Tim Murphy, "This Former Cocaine Kingpin Is Lobbying Congress to Let Him Keep His Cheetahs (and Liger)," *Mother Jones*, May 7, 2014, <https://www.motherjones.com/politics/2014/05/mario-tabraue-cocaine-kingpin-lobbying-congress-big-cats/>.

182. Other causes cited by the authors include cannibalism, crushing, dehydration, emaciation, hypothermic stress, infestation, starvation, overcrowding, stress, and other injuries. Shawn Ashley, Susan Brown, Joel Ledford, Janet Martin, et al., "Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler," *J Appl Anim Welf Sci* 17, No. 4: 308-21, doi: 10.1080/10888705.2014.918511.

183. Shawn Ashley, Susan Brown, Joel Ledford, Janet Martin, et al., "Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler," *J Appl Anim Welf Sci* 17, No. 4: 308-21, doi: 10.1080/10888705.2014.918511.

184. Shawn Ashley, Susan Brown, Joel Ledford, Janet Martin, et al., "Morbidity and Mortality of Invertebrates, Amphibians, Reptiles, and Mammals at a Major Exotic Companion Animal Wholesaler," *J Appl Anim Welf Sci* 17, No. 4: 308-21, doi: 10.1080/10888705.2014.918511.

usually at auction or through online sales.^{185 186} Exotic pet auctions take place all over the United States with a large number in Texas and Ohio. At the Mid Ohio Alternative Animal and Bird Sale in Mt. Hope, Ohio, over 100 species are available for sale at what is considered one of the largest exotic animal auctions in the country.¹⁸⁷ At exotic animal auctions, animals from across the region are brought to a single location to be auctioned off to the highest bidder, although, today, many of these events also take place virtually with online bidders. Auctions include a wide range of species: kangaroos, pythons, primates, zebras, bobcats, sloths, turkeys, camels, water buffalo, and others. These animals are often bought to be kept as pets, to be used in captive hunting operations, or to become breeding stock. During and after the auction, animals of many species are confined in small spaces next to one another, stressed and, often, in poor condition. Many major auctions, particularly those dealing in large animals, require health papers for consignments.^{188 189} Other auctions, however, especially those held online, do not require health inspections.¹⁹⁰ Reports of the Mt. Hope Auction indicate that purchasers—even those buying rare and dangerous exotic animals—are not required to provide their name or address, making it extremely difficult for health officials to trace back the origins of a zoonotic outbreak should one occur.¹⁹¹

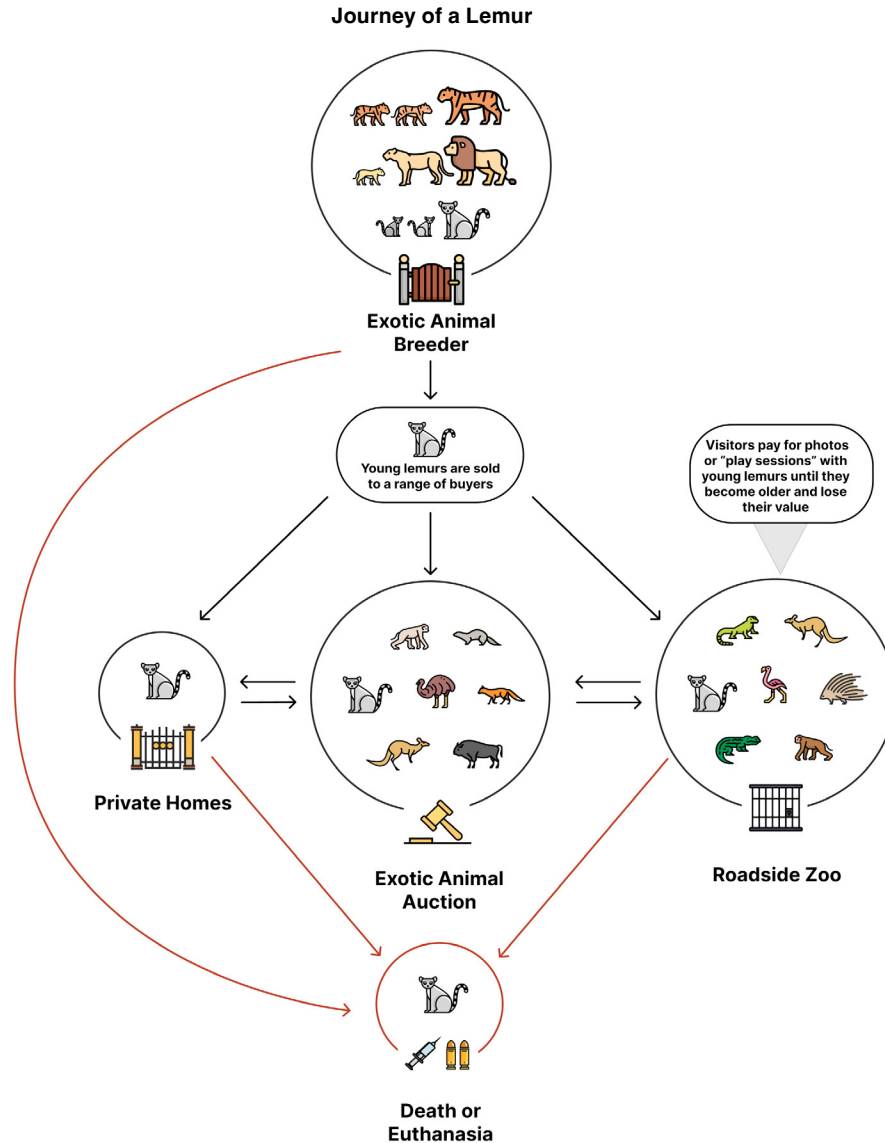
Digitally-enabled captive wildlife transactions are also growing. Consumers acquire exotic pets both legally and illegally through online marketplaces, pet stores, exotic pet auctions, and swap meets.^{192 193} In recent years, because many pet stores, auctions, breeders, and distributors have begun providing online direct-to-consumer channels, animals of all kinds are now visible and available for purchase from anywhere in the country.



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185. Dan Eaton, "Exotic Animals 'Easy' to Buy at Auctions," *BizJournals*, October 19, 2011, <https://www.bizjournals.com/columbus/blog/2011/10/exotic-animals-easy-to-buy-at.html>.
186. Carney Anne Nasser, "Welcome To The Jungle: How Loopholes In The Federal Endangered Species Act And Animal Welfare Act Are Feeding A Tiger Crisis In America," *GLR* 9, No. 1 (April 14, 2016), <https://www.albanygovernmentlawreview.org/article/23971-welcome-to-the-jungle-how-loopholes-in-the-federal-endangered-species-act-and-animal-welfare-act-are-feeding-a-tiger-crisis-in-america>.
187. Mt. Hope Auction Website, accessed May 25, 2023, <https://mthopeauction.com/>.
188. 5-HRanch Exotic Animal Auction Website, accessed May 26, 2023, <https://5-hauction.com/>.
189. Wild Side Auction Services Website, accessed May 26, 2023, <https://wildsideauctionservices.com/>.
190. ExoticAuction.com Website, accessed May 26, 2023, <https://exoticauction.com/>.
191. Personal interview with retired Ohio police officer and expert on exotic pets and large cats, May 18, 2021.
192. The 2010 documentary *The Elephant in the Living Room* offers unique footage of the magnitude of species offered at these exotic pet auctions, the bleak conditions these animals are kept in, and their popularity. *The Elephant in the Living Room*, 2010, Director Michael Webber, <http://www.theelephantinthelivingroom.com>.
193. Swap meets are places where people buy, sell, or trade animals, usually in an open-air, flea-market-style setting. Swap meets usually exist out of the public and regulatory eye, and can be venues for both legal animal sales and illegal transactions. For more information, see our discussion on Swap Meets.

In many cases, the journey of an exotic animal, such as a lemur or a big cat, can be long and winding, bouncing from a zoo to an auction to a private home and back again. Many of these animals ultimately die of illness or are killed or euthanized, while some end up at sanctuaries or are illegally exported.^{194 195}



Keeping wild animals as pets creates substantial risk for zoonotic spillover, as 60%–75% of recently emerging zoonotic pathogens have come from wildlife.¹⁹⁶ Wild animals imported to supply the exotic pet trade are often sourced from areas of high biodiversity, which are often also hotspots of emerging infectious diseases. Given that these animals live alongside people as pets, and typically undergo no health screenings prior to entering the country, they present a particularly acute risk of

194. The term “big cats” is used to describe any large member of the cat family, species such as lions, tigers, leopards, jaguars, snow leopards, clouded leopards, cheetahs, and cougars.

195. The Captive Wildlife Safety Act of 2003, which amended the Lacey Act, prevents the movement of big cats across state lines or across the U.S. border except by entities licensed with the USDA. The Big Cat Public Safety Act of 2022 added additional restrictions, including the prohibition of private ownership of big cats as well as prohibiting exhibitors from allowing public contact with big cats, including cubs. However, sale and transport is still continuing despite these prohibitions. “Captive Wildlife Safety Act,” 117 Stat. 2871 and 2872, <https://www.govinfo.gov/app/details/PLAW-108publ191/summary>. See also “The Big Cat Public Safety Act,” Public Law No: 117-243, December 20, 2022, <https://www.congress.gov/bill/117th-congress/house-bill/263/text>.

196. Joel Henrique Ellwanger and José Artur Bogo Chies, “Zoonotic Spillover: Understanding Basic Aspects for Better Prevention,” *Genetics and Molecular Biology* 44, No. 1 Supp 1 (2021): doi: 10.1590/1678-4685-GMB-2020-0355.

zoonotic transmission and of introducing foreign zoonoses into the United States.¹⁹⁷

The exotic pet trade is problematic from a public health standpoint because it brings high-risk species of wildlife into American homes, paving the way for close human-animal interactions that serve as potential flashpoints for spillover of zoonotic disease. For example, in 2003, an outbreak of mpox, a disease from the same family of virus as smallpox, swept across much of the Midwest and infected 72 people who came in contact with pet prairie dogs.^{198 199}

Some zoonoses carried by pets are relatively common. For example, studies have shown that at least 50%–90% of snakes, turtles, and lizards are carriers of *Salmonella*; across the United States, these animals are handled and held by individuals, often children, with few sanitary precautions.^{200 201 202 203} Other diseases are rare but can be quite deadly.

For example, though primates represent a small percentage of the total number of exotic pets in the United States, they pose a unique risk to humans due to the genetic similarity between our species and theirs. Yellow fever, Ebola, dengue, viral hepatitis, and disease caused by poxviruses are all potentially deadly if transmitted from primates to humans.²⁰⁴ In addition, past research has found that 80%–90% of macaque monkeys, one of the most popular primate species kept as pets in the United States, are infected with herpes B—a virus that can result in severe brain damage or death in humans.²⁰⁵ Monkeys have also been shown to transmit bacterial zoonotic diseases to humans including tuberculosis and others.²⁰⁶

The exotic pet trade is problematic from a public health standpoint because it brings high-risk species of wildlife into American homes.



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197. Nina Marano, Paul M. Arguin, and Marguerite Pappaioanou, "Impact of Globalization and Animal Trade on Infectious Disease Ecology," *Emerging Infectious Diseases* 13, No. 12 (December 1, 2007): 1807–10.
198. B.Lee Ligon, "Monkeypox: A Review of the History and Emergence in the Western Hemisphere," *Semin Pediatr Infect Dis* 15, No. 4 (October 2004): 280–287, doi: 10.1053/j.spid.2004.09.001.
199. NPR, "Rare Monkeypox Outbreak in U.K., Europe and U.S.: What Is It and Should We Worry?" *All Things Considered*, May 20, 2022, [npr.org/sections/goatsandsoda/2022/05/18/927043767/rare-monkeypox-outbreak-in-u-k-and-europe-what-is-it-and-should-we-worry](https://www.npr.org/sections/goatsandsoda/2022/05/18/927043767/rare-monkeypox-outbreak-in-u-k-and-europe-what-is-it-and-should-we-worry).
200. Jong, Birgitta De et al. "Effect of Regulation and Education on Reptile-Associated Salmonellosis." *Emerging Infectious Diseases* 11, No. 3 (March 2005): 398–403, doi:10.3201/eid1103.040694.
201. Nina Marano, Paul M. Arguin, and Marguerite Pappaioanou, "Impact of Globalization and Animal Trade on Infectious Disease Ecology," *Emerging Infectious Diseases* 13, No. 12 (December 1, 2007): 1807–10.
202. Ross Moore and David Griffen, "Hantavirus Syndrome," *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan, <https://www.ncbi.nlm.nih.gov/books/NBK513243/>.
203. "Tularemia—United States, 2001–2010," *CDC Morbidity and Mortality Weekly Report* (MMWR), November 29, 2013, <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6247a5.htm>.
204. National Research Council (US) Committee on Occupational Health and Safety in the Care and Use of Nonhuman Primates, *Occupational Health and Safety in the Care and Use of Nonhuman Primates* (Washington DC: National Academies Press, 2003), 3, Identifying Infectious Hazards Associated with the Use of Nonhuman Primates in Research, <https://www.ncbi.nlm.nih.gov/books/NBK43452/>.
205. Stephanie Ostrowski et al. "B-Virus from Pet Macaque Monkeys: An Emerging Threat in the United States?" *Emerging Infectious Diseases*. 4, No. 1 (1998):117–121, doi:10.3201/eid0401.980117.
206. National Research Council (US) Committee on Occupational Health and Safety in the Care and Use of Nonhuman Primates, *Occupational Health and Safety in the Care and Use of Nonhuman Primates* (Washington DC: National Academies Press, 2003), 3, Identifying Infectious Hazards Associated with the Use of Nonhuman Primates in Research, <https://www.ncbi.nlm.nih.gov/books/NBK43452/>.

Disease risks are often amplified by owners who are unaware of the unique medical, nutritional, behavioral, psychological, physical, and sanitary needs of these exotic animals. Poor husbandry can lead to suboptimal physical health, mental distress, and can create an environment ripe for zoonotic transmission. Furthermore, keeping exotic animals as pets in the home or in close confinement to humans allows for intimate human-animal interactions that facilitate the spread of disease through airborne particles, direct contact with the animal, saliva, blood, or waste, as well as through insects and other vectors. Even petting animals and being licked or cut/scratched by them can transmit deadly diseases such as mpox, hantavirus, hepatitis, tularemia, and salmonellosis.

While the exotic pet trade is vast in scale, it is also largely invisible. Many of the transactions happen online or out of public view, as exotic pet auctions and swap meets typically do not allow cameras. Sales frequently take place without adequate record-keeping. The exotic pet industry has proven highly resistant to regulation and benefits from lack of visibility; exotic pets themselves are kept indoors or out of sight—in attics, backyard sheds, or basements. Yet, the catalog of species and associated diseases involved in the trade is seemingly endless.²⁰⁷ As a result, law enforcement, doctors, and other first responders are generally unfamiliar and ill-equipped to deal with many of these foreign or uncommon diseases (which may prove particularly difficult to diagnose in patients with no history of travel).²⁰⁸

Regulatory oversight of the exotic pet trade in the United States is limited. Most federal regulation is concerned primarily with animals protected by the Endangered Species Act (ESA) or by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), although these species constitute only a small fraction of the animals commonly kept as exotic pets.²⁰⁹ The Animal Welfare Act requires breeders, wholesalers, dealers, transporters, and sellers of exotic and wild animals to be licensed but only provides limited oversight and does not apply to small operations with fewer than five breeding females, or fewer than nine small exotic pets.^{210 211 212} Moreover, the AWA's provisions have little direct impact on disease risk, and the Act exempts broad categories of animals—including reptiles, amphibians, birds, and “pocket pets,” such as ferrets, sugar gliders, hamsters, hedgehogs, mice, rats, prairie dogs, flying squirrels, chinchillas, and others who are capable of carrying zoonotic disease.²¹³



207. Jani Hall, “Exotic Pet Trade, Explained” *National Geographic*, February 20, 2019, <https://www.nationalgeographic.com/animals/article/exotic-pet-trade>.
208. These animals pose additional safety risks to first responders who have no way of knowing whether the residence they are responding to may contain exotic animals. As a result, the National Sheriffs Association, the Fraternal Order of Police, and other groups have supported legislation that would regulate private ownership of big cats.
209. The Endangered Species Act prohibits the possession, selling, delivering, carrying, transporting, importing, exporting, or shipping of any endangered species of fish or wildlife. The Lacey Act makes it an offense to traffic in wildlife, fish, or plants that have been illegally acquired. Falsification of documents for shipments of wildlife and the failure to mark shipments of wildlife are made illegal under this act. The Big Cat Public Safety Act of 2022 Act further regulates interstate commerce in eight species of big cats.
210. “Questions and Answers: Thresholds for De Minimis Activity and Exemptions From Licensing under the Animal Welfare Act,” *USDA Animal and Plant Inspection Service*, last updated Aug 3, 2016, <https://www.aphis.usda.gov/aphis/newsroom/factsheets/questions-and-answers-awa-deminimis>.
211. “Thresholds for De Minimis Activity and Exemptions From Licensing Under the Animal Welfare Act,” *USDA Animal and Plant Health Inspection Service*, Federal Register 83 FR 25549, June 4, 2018, <https://www.federalregister.gov/documents/2018/06/04/2018-11892/thresholds-for-de-minimis-activity-and-exemptions-from-licensing-under-the-animal-welfare-act>.
212. The Office of the Inspector General of the USDA has criticized the USDA multiple times for failing to enforce the AWA. For more information on AWA violations and lack of enforcement see “Reports—Inspection / Evaluation,” *USDA OIG*, accessed May 31, 2023, <https://usdaoig.oversight.gov/reports/list/inspection-evaluation>.
213. “Licensing and Registration Under the Animal Welfare Act: Guidelines for Dealers, Exhibitors, Transporters, and Researchers,” *USDA Animal and Plant Health Inspection Service*, Program Aid No. 1117, February 2019, <https://naldc.nal.usda.gov/catalog/7257529>.

Without effective national oversight, states are left to create their own laws to regulate the exotic pet industry. Most states impose laws pertaining to the ownership of certain exotic animals, although their restrictions vary widely. Three states (Alabama, North Carolina, and Wisconsin) still impose no regulation of the private ownership of exotic animals.²¹⁴ Other states may restrict and ban ownership by species, require licensing, require a certificate of veterinary inspection, or simply require proof of adequate housing.^{215 216 217 218 219 220} There is wide variation from one state to the next in terms of which animals are regulated and in what ways, creating a patchwork of regulatory oversight. In some cases, the same species may be owned legally in some parts of the country but not others.²²¹ By and large, when regulations do exist, they are primarily concerned with animals deemed to present a physical threat to public safety, for example, big cats and venomous snakes. However, regulators rarely factor disease risk into this calculus, despite the fact that it has the potential to cause far greater harm than claws or fangs.

Three states (Alabama, North Carolina, and Wisconsin) still impose no regulation of the private ownership of exotic animals.

2. Pet Stores

Pet stores in the United States sell a variety of domestic animals, such as dogs and cats, but also dozens of species of exotic animals including rodents, amphibians, reptiles, fish, birds, and many others. The pet trade is a large industry in the United States—with 67% of U.S. households, or about 85 million families, owning a traditional pet such as a dog or cat, and 18 million households owning one or more exotic pets.^{222 223} Exotic pets sold in pet stores come from a variety of sources, both foreign and domestic. The type and size of producer also varies widely. For example, bird breeders range from “backyard breeders” or hobbyists with just a few birds to huge wholesale facilities where thousands of exotic birds are bred.

Ninety percent of the puppies sold in pet stores are originally sourced from large scale commercial breeders, sometimes known as puppy mills.²²⁴ These animals commonly carry health

214. “Big Cat Public Safety Act (Federal),” *Animal Legal Defense Fund*, last modified June 16, 2022, <https://aldf.org/project/big-cat-public-safety-act/>.

215. Iowa, for example, bans ownership of any “dangerous wild animal,” and enumerates a list of qualifying species. Dangerous Wild Animals 21, Iowa Admin Code 77, <http://www.uappeal.org/iowa.html>.

216. E.g. Texas Health and Safety Code, Chapter 882, Regulation of Animals, Subchapter E. Dangerous Wild Animals, <https://statutes.capitol.texas.gov/SOTWDocs/HS/htm/HS.822.htm>.

217. North Dakota requires a license for Category 3 animals, which include bears, wolves, primates, and all non-domesticated felines except bobcats. “North Dakota Administrative Code. Title 48.1. State Board of Animal Health. Article 48.1-09. Nontraditional Livestock,” *Animal Legal and Historical Center*, last modified May 2020, <https://www.animallaw.info/administrative/nd-wildlife-possessionrehabilitation-article-48-12-nontraditional-livestock>.

218. 12 Maine Rev. Statutes §12151 et. al., <http://www.uappeal.org/maine.html>.

219. Ex. Pennsylvania, New Jersey, Mississippi. “State Laws for Keeping Exotic Cats as Pets,” *Big Cat Rescue*, accessed May 31, 2023, <https://bigcatrescue.org/state-laws-exotic-cats/>.

220. Certain loopholes in USDA regulation allows some operators to circumvent state laws. A USDA OIG report found that 70% of exhibitors with four or fewer exotics, in fact, did not qualify as “exhibitors,” but instead obtained the USDA license in order to overcome state and local laws that prevent private ownership of exotics. “Controls Over APHIS Licensing of Animal Exhibitors,” *USDA Office of Inspector General*, Audit Report 33601-10-Ch, June 2010, <https://www.usda.gov/sites/default/files/33601-10-CH.pdf>.

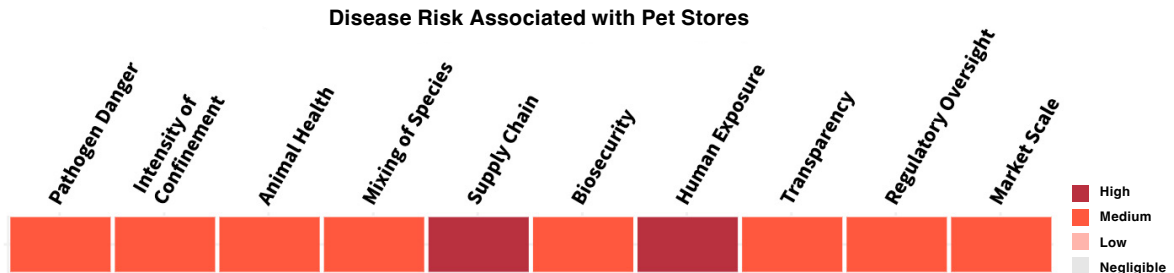
221. Most states choose to enumerate the specific animals banned or regulated, rather than using blanket language with a broader scope, while the list of species included varies from one state to the next. Matthew Liebman, “Detailed Discussion of Exotic Pet Laws,” *Michigan State University College of Law*, Animal Legal and Historical Center, 2004, <https://www.animallaw.info/article/detailed-discussion-exotic-pet-laws>.

222. American Pet Products Association, “Pet Industry Market Size, Trends & Ownership Statistics,” accessed May 31, 2023, https://www.americanpetproducts.org/press_industrytrends.asp.

223. American Veterinary Medical Association, “U.S. Pet Ownership Statistics. 2017-2018” *U.S. Pet Ownership & Demographics Sourcebook*, accessed May 31, 2023, <https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics#exotic>.

224. “Buyer Beware: The Problem with Puppy Mills and Backyard Breeders,” *Paws.org*, accessed May 31, 2023, <https://www.paws.org/resources/puppy-mills/>.

problems and may have weakened immune systems.^{225 226 227} For example, in January 2018, the CDC was called in to contain the spread of a string of multidrug-resistant *campylobacter* infections that sickened 118 individuals, including 29 pet store employees across 18 states, and that was spread by diseased pet store puppies.²²⁸



Very little is known about the animals entering pet stores—physically, medically, or behaviorally. Rarely do pet stores provide customers with information about the source of their animals, the animals’ medical history, or other relevant background. Indeed, in many cases, pet stores themselves may lack access to this information. Pet stores may source their animals from a dozen or more different suppliers within the country and abroad, making record keeping more difficult. Because of this, pet stores also act as a potential locus for disease with large numbers of animals coming together in one place, bringing with them whatever pathogens they may have encountered along the supply chain.

Very little is known about the animals entering pet stores—physically, medically, or behaviorally.

Once inside a pet store, animals are usually housed in small enclosures with or close to many other animals of the same species and often in close proximity to other species. These conditions can easily result in disease transmission within and across different animal species. Typically, animals sold in pet stores have not been thoroughly vetted for disease. This is especially true for low-cost animals where providing veterinary care may not make economic sense for the seller.

These risk factors are coupled with close human-animal interactions, involving both pet store employees as well as customers. Customers, and in particular children, often hold and touch animals, frequently interacting with different species throughout a single visit. Visiting pet stores sometimes serves as a form of leisure activity, with families visiting to observe and handle the animals, even without any intention of purchasing a pet. These conditions culminate in a substantial risk of zoonotic spillover, particularly where proper sanitation is not employed. A sick animal in a pet shop can potentially transmit a pathogen to other animals within the shop, and ultimately to a large, broadly dispersed set of visitors. For example, a single rabid kitten for sale at one U.S. pet shop exposed 665 people to the disease, requiring

225. Angelo Gazzano, Chiara Mariti, Lorella Notari, Claudio Sighieri and Elizabeth Anne McBride, “Effects of Early Gentling and Early Environment on Emotional Development of Puppies,” *Applied Animal Behaviour Science* 110, No. 3–4 (April 2008): 294–304, <https://doi.org/10.1016/j.applanim.2007.05.007>.

226. Grace Boone, “Welfare Implications of Early Neurological Stimulation for Puppies in Commercial Breeding Kennels,” *Purdue University Graduate School*, December 16, 2022, <https://doi.org/10.25394/PGS.13093532.v1>.

227. Firdaus Dhabhar and Bruce McEwen, “Acute Stress Enhances While Chronic Stress Suppresses Cell-Mediated Immunity in Vivo: a Potential Role for Leukocyte Trafficking,” *Brain, Behavior, and Immunity* 11, No. 4 (December 1997): 286–306, <https://doi.org/10.1006/brbi.1997.0508>.

228. Martha P Montgomery et al., “Multidrug-Resistant *Campylobacter jejuni* Outbreak Linked to Puppy Exposure - United States, 2016–2018,” *MMWR. Morbidity and Mortality Weekly Report* 67, No. 37 (September 21, 2018): 1032–1035, doi:10.15585/mmwr.mm6737a3.

all of them to receive prophylactic rabies treatment, costing taxpayers over \$1 million dollars.²²⁹

The wide catalog of species in pet stores presents a diverse range of disease risks. Exotic animals such as parrots, ferrets, chinchillas, hedgehogs, and turtles can each harbor a unique range of zoonotic pathogens, especially if raised in unsanitary conditions.^{230 231 232} Parrots, for example, may carry avian influenza as well as psittacosis.²³³ Reptiles most often carry bacterial pathogens such as *Salmonella*.²³⁴ The CDC estimates that roughly 7% of salmonella cases in the United States are associated with the handling of reptiles and as many as 50%–90% of snakes, turtles, and lizards carry *Salmonella*.^{235 236} Frogs and toads are also frequent carriers.²³⁷ The high rates of bacterial disease in reptiles and amphibians may be linked to poor care and suboptimal living conditions. Studies have found that poor treatment of these animals and stress may lead to metabolic imbalances, low immunity, and poor hygiene, all of which contribute to the risk of transmission of this and other pathogens.²³⁸ In addition, *Salmonella* outbreaks have originated from shipments of frozen feeder mice, which are sold to feed carnivorous pets, with some shipments infecting customers across 21 states.²³⁹ A wide range of other zoonotic diseases has been reported from pet stores including lymphocytic choriomeningitis (transmitted from hamsters), leptospirosis (transmitted from mice), tularemia (transmitted from rabbits), mpox (transmitted from prairie dogs), and toxocariasis (transmitted from dogs).^{240 241}

Pet stores could play an important role in educating customers about the risk of zoonotic disease, as they are often the initial touchpoint where customers receive information about their new pet. However, in most cases, pet stores do not provide meaningful information related to zoonotic risks, risk mitigation, and proper animal husbandry.

Further, pet store employees themselves are rarely trained about the risks of zoonotic disease and some are unaware altogether that disease can spread from animals to humans.^{242 243}

229. Kate Halsby, Amanda Walsh, Colin Campbell, Kirsty Hewitt, Dilys Morgan, “Healthy Animals, Healthy People: Zoonosis Risk from Animal Contact in Pet Shops, a Systematic Review of the Literature,” *PLoS ONE* 9, No. 2: e89309 (February 26, 2014). <https://doi.org/10.1371/journal.pone.0089309>.
230. Dina Fine Maron, “Major U.S. Chinchilla Supplier Heads to Court with More than 100 Animal Welfare Violations,” *National Geographic*, July 28, 2021, <https://www.nationalgeographic.com/animals/article/major-chinchilla-supplier-heads-to-court-with-more-than-100-animal-welfare-violations>.
231. Clifford Warwick, Phillip C Arena, and Catrina Steedman, “Health Implications Associated with Exposure to Farmed and Wild Sea Turtles,” *JRSM Short Rep.* 4, No. 1 (Jan 2013): 8, doi: 10.1177/2042533313475574.
232. “Ferrets,” *Centers for Disease Control and Prevention*, last updated March 8, 2022, <https://www.cdc.gov/healthypets/pets/ferrets/index.html>.
233. E.F. Kaleta, K.M. Blanco Peña, A. Yilmaz, T. Redmann, & S. Hofheinz, “Avian Influenza A Viruses in Birds of the Order Psittaciformes: Reports on Virus Isolations, Transmission Experiments and Vaccinations and Initial Studies on Innocuity and Efficacy of Oseltamivir in Ovo,” *Deutsche Tierärztliche Wochenschrift* 114, No. 7 (July 2007): 260–267, <https://pubmed.ncbi.nlm.nih.gov/17724934/>.
234. “Reptiles and Amphibians,” *Centers for Disease Control and Prevention*, last updated November 16, 2022, <https://www.cdc.gov/healthypets/pets/reptiles.html>.
235. Bruno B. Chomel, Albino Belotto, and François-Xavier Meslin, “Wildlife, Exotic Pets, and Emerging Zoonoses,” *Emerging Infectious Diseases* 13, No. 1 (January 2007): 6–11, <https://doi.org/10.3201/eid1301.060480>.
236. Birgitta De Jong et al. “Effect of Regulation and Education on Reptile-Associated Salmonellosis.” *Emerging Infectious Diseases* 11, No. 3 (March 2005): 398–403, doi:10.3201/eid1103.040694.
237. Centers for Disease Control and Prevention, “Reptile-Associated Salmonellosis—Selected States, 1994-1995,” *MMWR* 44, No. 17 (May 5, 1995): <https://www.cdc.gov/mmwr/preview/mmwrhtml/00037004.htm>.
238. Jairo Mendoza-Roldan, David Modry, Domenico Otranto, “Zoonotic Parasites of Reptiles: A Crawling Threat,” *Trends in Parasitology* 36, No. 8 (August 1, 2020): 677–687. <https://doi.org/10.1016/j.pt.2020.04.014>.
239. “Multistate Outbreak of Human Salmonella Typhimurium Infections Linked to Frozen Feeder Rodents,” *Centers for Disease Control and Prevention*, last modified June 20, 2014, <https://www.cdc.gov/salmonella/typhimurium-rodents-05-14/index.html>.
240. Kate Halsby, Amanda Walsh, Colin Campbell, Kirsty Hewitt, & Dilys Morgan, “Healthy Animals, Healthy People: Zoonosis Risk from Animal Contact in Pet Shops, a Systematic Review of the Literature,” *PLoS ONE* 9, No. 2, e89309 (February 26, 2014): <https://doi.org/10.1371/journal.pone.0089309>.
241. In 2022 hamsters in a pet store in Hong Kong were found to transmit SARS-CoV-2 to humans. Smriti Mallapaty, “How Sneezing Hamsters Sparked a COVID Outbreak in Hong Kong,” *Nature*, February 4, 2022, doi: <https://doi.org/10.1038/d41586-022-00322-0>.
242. Kate Halsby, Amanda Walsh, Colin Campbell, Kirsty Hewitt, & Dilys Morgan, “Healthy Animals, Healthy People: Zoonosis Risk from Animal Contact in Pet Shops, a Systematic Review of the Literature,” *PLoS ONE* 9, No. 2, e89309 (February 26, 2014): <https://doi.org/10.1371/journal.pone.0089309>.
243. One study based in the United Kingdom found that 36% of pet store employees were not aware that disease can be transmitted from animals to humans. While COVID-19 may have increased awareness among the public of the zoonotic risks posed by handling animals, there are no more recent studies available at the present time. Kate Halsby, Amanda Walsh, Colin Campbell, Kirsty Hewitt, & Dilys Morgan, “Healthy Animals, Healthy People: Zoonosis Risk from Animal Contact in Pet Shops, a Systematic Review of the Literature,” *PLoS ONE* 9, No. 2, e89309 (February 26, 2014): <https://doi.org/10.1371/journal.pone.0089309>.

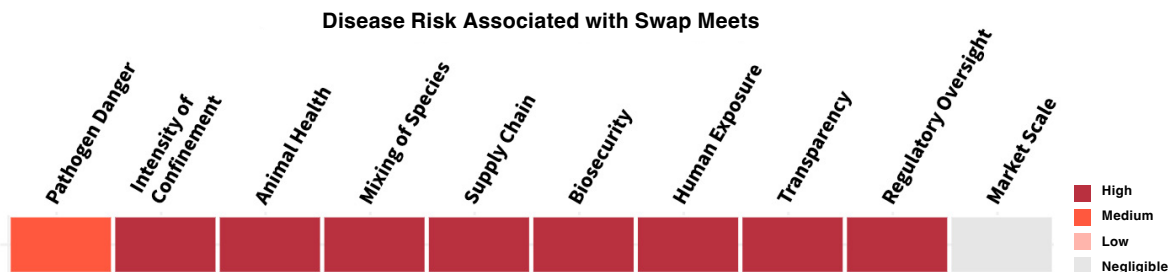
Fewer than half of U.S. states require pet stores to obtain a license.

Retail pet shops are exempt from the Animal Welfare Act and remain largely unregulated.²⁴⁴ As a result, states serve as the primary regulators of retail pet stores, with wide variation in laws from one state to the next. Fewer than half of U.S. states require pet stores to obtain a license. Apart from the initial licensing, there is very little

opportunity for inspection. Only 21 states require proper housing and regular cleaning for animals in pet stores. A majority of states, 34, do not require that pet stores provide any veterinary care for their animals.²⁴⁵
²⁴⁶ Very few state laws, if any, aim to address zoonotic disease risk from pet store animals.²⁴⁷

3. Swap Meets

Swap meets are large markets, typically outdoors, where a range of animal species both wild and domestic can be bought or sold. In contrast to live animal markets where animals are purchased solely to slaughter and eat, animals at swap meets are usually obtained to be kept as pets, though many animals at swap meets are purchased to be eaten. Swap meets are similar in style to flea markets, with a variety of vendors often each selling many types of animals. The meets are particularly common in the Midwest and South, sometimes taking place in indoor arenas. One of the largest swap meets in the country takes place in Canton, Texas and hosts thousands of sales booths spanning several acres and attracting up to 500,000 shoppers per weekend.²⁴⁸



Animals commonly sold at swap meets include domestic animals such as rabbits, geese, ducks, chickens, goats, ponies, pigs, kittens, and puppies as well as a wide range of exotic animals including parrots, snakes, spiders, and hedgehogs. These animals come from both legal and illegal and domestic and international sources. Because of the lack of government oversight, swap meets serve as a preferred outlet for illegally smuggled exotic animals, such as rare tortoises from Asia and parrots from Mexico.²⁴⁹

244. The Animal Welfare Act defines a retail pet store to mean a location where the seller, buyer, and the animal available for sale (for the purpose of being a pet) are physically present. Those who sell animals for pets where the buyer is not physically present must obtain an AWA license and are monitored by the USDA. "Animal Welfare; Retail Pet Stores and Licensing Exemptions," *USDA Animal and Plant Health Inspection Service*, 9 CFR Parts 1 and 2 101 (2013): 57227-57250.

245. "Retail Pet Sale Bans: Stopping the Puppy Mill Pipeline," *American Legal Defense Fund*, accessed May 31, 2023, <https://aldf.org/article/protecting-animals-through-local-legislation/retail-pet-sale-bans/>.

246. "States with Humane Pet Sales Laws," *Best Friends*, accessed May 31, 2023, <https://bestfriends.org/advocacy/ending-puppy-mills/states-humane-pet-sales-laws>.

247. Five states (California, Maine, Maryland, Washington, and Illinois) and hundreds of cities have moved to ban retail pet store sales of dogs and cats sourced from breeders. These laws were driven in part by concerns about the health of animals sourced from commercial breeding facilities. In addition to these bans, many states employ "puppy lemon laws" to protect consumers' financial investment when purchasing an animal who is likely to have health issues. However, these laws do not protect consumers from exposure to diseases that their new pet may carry.

248. First Monday Trade Days," *CantonTradeDays*, accessed May 22, 2022, www.cantontradedays.com.

249. "12 Seized Shipments: The Exotic Animal Trade," *CNBC*, September 13, 2013, <https://www.cnn.com/2012/05/16/12-Seized-Shipments-The-Exotic-Animal-Trade.html>.

Swap meets are also a convenient platform for large scale commercial dog breeders who want to avoid regulation and increase profit margins by selling dogs directly to consumers in informal, often unregulated settings.²⁵⁰ Animals at swap meets are regularly sold without record. During the 2003 mpox outbreak, for example, CDC agents were unable to track down more than 100 of the infected prairie dogs who had been sold through swap meets, where both buyers and sellers operate largely anonymously and transactions occur with little or no documentation.²⁵¹ ²⁵² Investigators ran into similar headwinds during a 2015 multi-state outbreak of salmonella caused by contact with turtles. This outbreak infected 143 people (hospitalizing 32%), including a patient who had purchased turtles illegally at a swap meet in Alabama.²⁵³ Fewer than half of infected patients were able to identify whom they had purchased their animals from, and public health investigators were not able to trace these animals back to their original supplier.

During the 2003 mpox outbreak, CDC agents were unable to track down more than 100 of the infected prairie dogs who had been sold through swap meets, where both buyers and sellers operate largely anonymously and transactions occur with little or no documentation.



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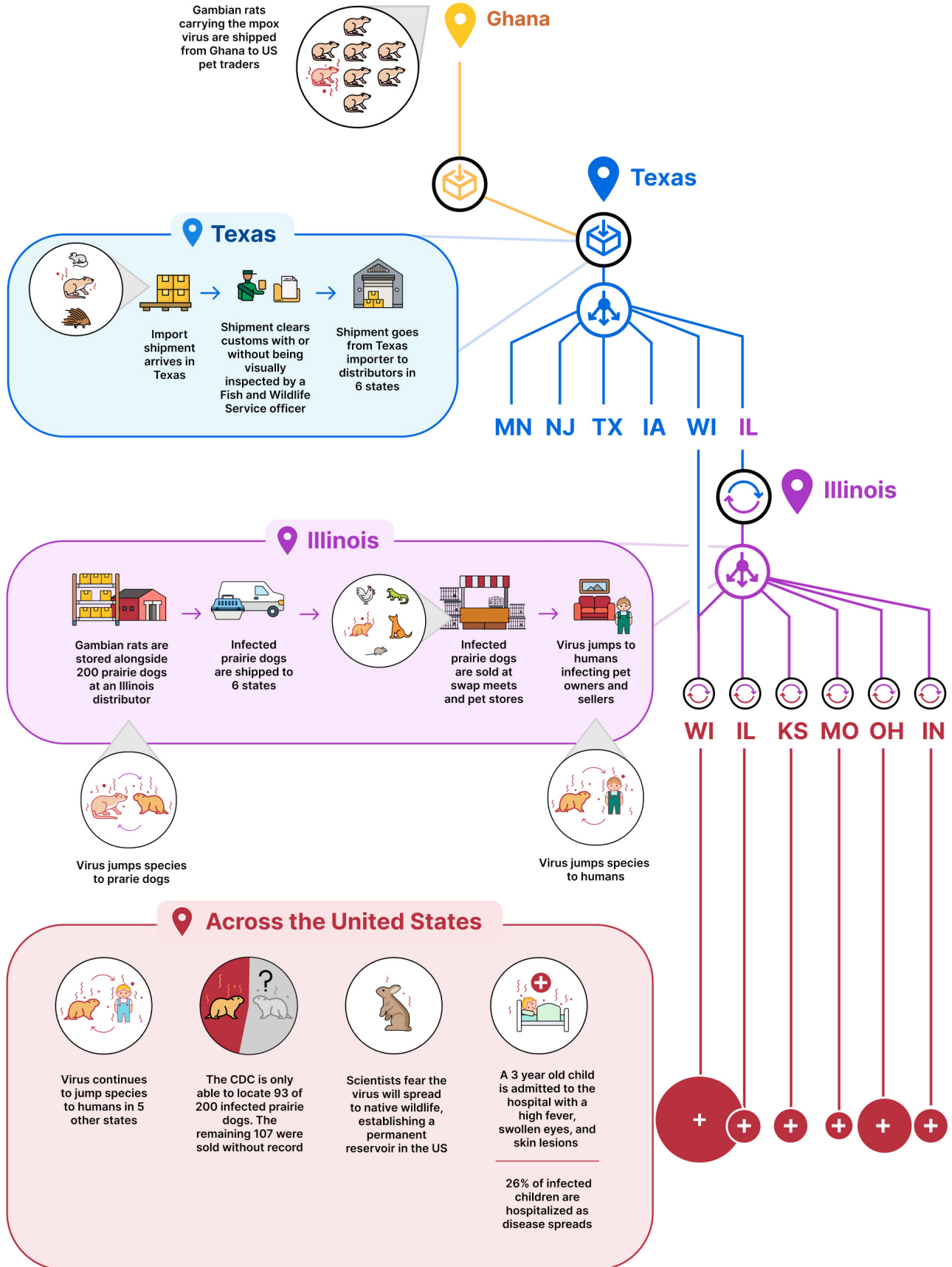
250. Zoe Friedland, "Detailed Discussion of Swap Meet Laws," *Michigan State University College of Law, Animal Legal & Historical Center*, 2016, <https://www.animallaw.info/article/detailed-discussion-swap-meet-laws>.

251. Susan Bernard and Steven Anderson, "Qualitative Assessment of Risk for Monkeypox Associated with Domestic Trade in Certain Animal Species, United States," *Emerging Infectious Diseases* 12, No. 12 (December 2006): 1827-33, doi:10.3201/eid1212.060454.

252. Robert Binning, "Chapter 231: Putting Swap Meet Animal Vendors in the Dog House: Regulating the Sale of Animals at Swap Meets," *McGeorge Law Review* 45, No. 3, Article 14 (January 2014): <https://scholarlycommons.pacific.edu/cgi/viewcontent.cgi?article=1037&context=mlr>.

253. K. Gambino-Shirley, L. Stevenson, J. Concepción-Acevedo, Eija Hyytiä-Trees et al., "Flea Market Finds and Global Exports: Four Multistate Outbreaks of Human Salmonella Infections Linked to Small Turtles, United States-2015," *Zoonosis and Public Health* 65, No. 29 (March 2018): <https://doi.org/10.1111/zph.12466>.

Anatomy of an Outbreak: Mpox Virus



Animals sold at swap meets often are transported and housed in cramped, unsanitary conditions. Each swap meet has its own set of restrictions and regulations set by the meet's organizer, and as a result, the types of animals sold and the conditions of their care vary greatly among markets. Generally though, conditions are wanting. Animals can be kept outside in extremely warm temperatures with little to no water. Cages are sometimes stacked above and on top of one another during sale and transport such that excrement or other fluids from one cage may leak into another below. The animals themselves are often unvaccinated, and many never have been examined by a veterinarian. Because of these conditions, swap meets present a clear risk not only for spreading disease among animals, but also for transmitting those same diseases to humans. Different species are held in close proximity to one another, creating additional pathways (and potential intermediate hosts) through which a virus may infect humans.²⁵⁴ This zoonotic risk is exacerbated by the fact that many swap meet attendees touch, hold, or examine animals as a form of entertainment without the intention of buying.

Swap meets are not well documented and operate largely out of sight of the general public. Many swap meet organizers ban photography and video recording. These venues often will remove journalists when identified. This lack of transparency with respect to the general public, as well as a lack of visibility among regulators and law enforcement, make swap meets more dangerous. And while swap meets can function as important centers for trade in rural communities, live animal trade and a lack of regulatory oversight leave them open to disease risk, fostering conditions and practices that are dangerous to both animal and human health. Even where regulations do exist, they are rarely enforced and tend to set only minimal standards of care, with little or no thought to zoonotic risk. Some states have restrictions against selling animals in public places, but these laws do not apply to swap meets, which usually are held on private property.²⁵⁵

4. Dog Breeders

Forty percent of U.S. households own a dog. Collectively, in 2022, Americans spent an estimated \$56 billion caring for these 77 million pets.^{256 257} Dogs are sourced from both small-scale and large commercial breeders, as well as animal shelters and rescue groups. In addition, the USDA estimates that approximately 1.1 million dogs are imported into the United States each year.²⁵⁸ The USDA fostered the creation of the dog breeding industry after World War II, though today, public funding is required to manage millions of unwanted animals.²⁵⁹

The USDA fostered the creation of the dog breeding industry after World War II, though today, public funding is required to manage millions of unwanted animals.

254. "No Bargain for the Animals: Swap Meets and Flea Markets," *BornFree USA*, October 23, 2009, <https://www.youtube.com/watch?v=ybGOVQ4kbUY>.

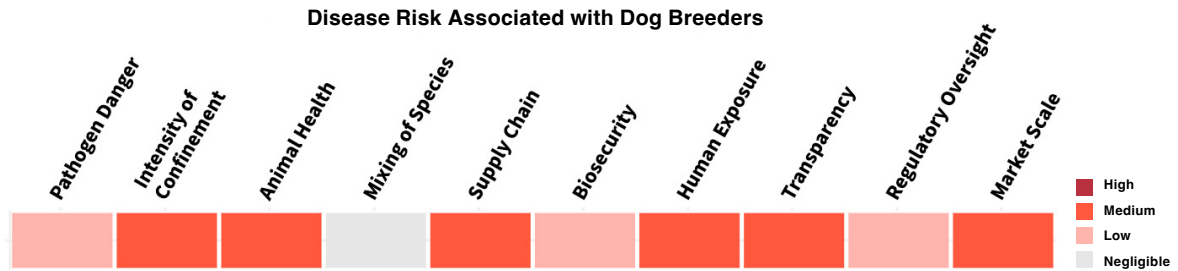
255. Zoe Friedland, "Detailed Discussion of Swap Meet Laws," *Michigan State University College of Law, Animal Legal & Historical Center*, 2016, <https://www.animallaw.info/article/detailed-discussion-swap-meet-laws>.

256. Estimated annual amount spent on dogs derived by multiplying the average spent per dog by the total number of U.S. dogs (\$730 x 76,811,305 = \$56,072,252,650). Michelle Megna, "Pet Ownership Statistics 2023," *Forbes*, accessed June 4, 2023, https://www.forbes.com/advisor/pet-insurance/pet-ownership-statistics/#sources_section.

257. "2017-2018 U.S. Pet Ownership & Demographics Sourcebook," *American Veterinary Medicine Association*, accessed May 31, 2023, <https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics>.

258. As of June 2021 the CDC issued a temporary suspension of the importation of dogs from 113 countries considered to be high risk for importing dog rabies. These countries include Turkey, China, Brazil, Peru, Jordan, Lebanon, and Saudi Arabia. Though only four cases of rabies have been found in imported dogs since 2016, exemptions to this suspension are limited and are said to be only approved for those bringing in three or fewer dogs.

259. This large-scale commercial breeding of dogs became popular after World War II when the USDA promoted these operations as a form of job creation in reaction to crop failures in the Midwestern United States. Hoping to adopt a more lucrative business model, as outlined by the government, many farmers converted chicken coops and rabbit hutches into housing for puppies whom they would sell to pet stores. "Puppy Mills Then and Now," *Humane Society of the United States*, 2012, <https://www.humanesociety.org/sites/default/files/docs/report-puppy-mills-then-now.pdf>.



In 2019, there were approximately 150,000 dog breeders in the United States producing over 2.4 million puppies annually and generating close to \$2 billion in annual revenue.²⁶⁰ Of these breeders, only 2,400 are licensed and subject to inspection by the USDA.²⁶¹ The market is highly decentralized with large commercial breeding operations (commonly referred to as puppy mills) that can house up to 1,000 dogs at one end of the spectrum and small-scale backyard breeders on the other.²⁶² Backyard breeders generally have no more than five breeding females, though many maintain four or fewer to avoid USDA oversight.²⁶³

It is estimated that 90% of puppies sold in pet stores are sourced from large-scale commercial breeders or “puppy mills.”²⁶⁴ These operations also feed online retail sales, which have gained popularity in recent years. Additionally, commercial breeders may offer their unsold dogs at auctions, with the two largest auctions taking place in Missouri. Each of these three value chains supplied by commercial breeders—pet stores, online sales, and auctions—is marked by a lack of transparency as are the facilities themselves. They are generally located in remote warehouses and not accessible to the public, maintaining a very scant digital footprint and public record.²⁶⁵



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There are about 14,000 animal shelters and rescue groups in the United States to care for and manage stray, unowned, or unwanted animals. Many shelters are publicly funded, though the dog breeding industry fuels much of the shelters’ animal intake. Approximately 25% of the 1.5 million dogs

260. Jack Curran, “Dog and Pet Breeders,” *IBISWorld*, Industry Report OD4643, December 2019.
 261. “Animal Care Program Oversight of Dog Breeders,” *Office of Inspector General*, USDA, Audit Report 33601-0002-31, June 2021, https://www.usda.gov/sites/default/files/audit-reports/33601-0002-31_final_distribution.pdf.
 262. In an ethnographic study done in the Bronx area of New York City, numerous families reported breeding their dogs in order to help pay their rent. Valerie McCarthy, “What it Means to Treat Rover Like a Family Member: Social Class and Companion Animals,” *New York University Masters Thesis*, New York University Department of Environmental Studies, 2019.
 263. “Questions and Answers: Thresholds for De Minimis Activity and Exemptions From Licensing under the Animal Welfare Act,” *USDA Animal and Plant Inspection Service*, last updated Aug 3, 2016, <https://www.aphis.usda.gov/aphis/newsroom/factsheets/questions-and-answers-awa-deminimis>.
 264. Kimberly Barnes, “Detailed Discussion of Commercial Breeders and Puppy Mills,” *Michigan State University College of Law*, Animal Legal & Historical Center, 2017, <https://www.animallaw.info/article/detailed-discussion-commercial-breeders-and-puppy-mills-0>.
 265. Paul Solotaroff, “The Dog Factory: Inside the Sickening World of Puppy Mills,” *Rolling Stone*, January 3, 2017, <https://www.rollingstone.com/culture/culture-features/the-dog-factory-inside-the-sickening-world-of-puppy-mills-112161/>.

Many of the same qualities that make these facilities frequent targets of criticism by animal welfare groups also make them susceptible to zoonotic disease: poor sanitation, limited air flow, excess waste, overcrowded conditions, poor animal health and welfare, and a lack of veterinary oversight.



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entering animal shelters in 2021 were purebred animals, likely bred by breeders.^{266 267}

The physical setup of breeding operations creates risk for zoonotic disease transmission along the supply chain. This is perhaps most true in large-scale commercial operations that tend to employ more intense forms of confinement, similar to those used in industrial agriculture. Many of the same qualities that make these facilities frequent targets of criticism by animal welfare groups also make them susceptible to zoonotic disease: poor sanitation, limited air flow, excess waste, overcrowded conditions, poor animal health and welfare, and a lack of veterinary oversight.^{268 269} Recent demand for “designer breeds,” such as goldendoodles, has augmented these concerns by reducing genetic diversity through intensive breeding of specific gene pools.^{270 271} USDA records also suggest that breeders will sometimes carry out veterinary procedures themselves without medical training.²⁷² These practices can include removing an animal's tail by twisting, ear cropping with scissors, or “de-barking” a dog by mangling its vocal chords. Some commercial breeding operations may also improperly dispose of dead animals.²⁷³

However, zoonotic risk is not limited to commercial breeders. Though hobby and backyard breeders often offer better living conditions, their dogs are usually bred and raised in the home or in close proximity to humans as well as other pets, creating additional opportunities for zoonotic transmission.

266. “Data Dashboards,” *Shelter Animals Count*, accessed May 31, 2023, <https://www.shelteranimalscount.org/data-dashboards>.

267. “Adopting from an Animal Shelter or Rescue Group,” *Humane Society of the United States*, accessed May 31, 2023, <https://www.humanesociety.org/resources/adopting-animal-shelter-or-rescue-group>.

268. “USDA Animal Care Search Tool, Inspections Reports,” USDA, accessed May 31, 2023, <https://aphis-efile.force.com/PublicSearchTool/s/inspection-reports>.

269. “The Horrible Hundred 2021: A Sampling of Problem Puppy Mills and Puppy Sellers in the United States,” *HSUS*, May 2021, https://www.humanesociety.org/sites/default/files/docs/2021_HorribleHundred.pdf.

270. Paul Overgaauw, Claudia Vinke, Marjan van Hagen, Len Lipman, “A One Health Perspective on the Human-Companion Animal Relationship with Emphasis on Zoonotic Aspects,” *International Journal of Environmental Research and Public Health* 17, No. 11 (2020): 7, <https://doi.org/10.3390/ijerph17113789>.

271. These overbred animals often experience genetic disorders that increase their susceptibility to disease and lifetime health defects, especially when combined with poor sanitary conditions. Lindsay Farrell, Jeffrey Schoenebeck, Pamela Wiener, et al., “The Challenges of Pedigree Dog Health: Approaches to Combating Inherited Disease,” *Canine Genetics and Epidemiology* 2, no 3 (2015): <https://doi.org/10.1186/s40575-015-0014-9>.

272. Clark Kauffman, “17 Iowa Dog Breeders Are Ranked Among the Worst in the Nation,” *Iowa Capital Dispatch*, May 16, 2022, <https://iowacapitaldispatch.com/2022/05/16/17-iowa-dog-breeders-are-ranked-among-the-worst-in-the-nation/>.

273. “Report Concerning Disposal of Dead Dogs at Commercial Breeding Facilities in Missouri,” *Humane Society of United States*, October 20, 2010, <https://www.humanesociety.org/sites/default/files/docs/report-disposal-dead-dogs.pdf>.

Pathogens transmissible from dogs to humans include bacteria, such as *Campylobacter*, *Giardia*, *Salmonella* and (less commonly in the United States) viruses such as rabies virus.²⁷⁴ In addition, imported dogs can also carry canine brucellosis and other vector-borne diseases such as ehrlichiosis, babesiosis, and leishmaniasis.²⁷⁵ Though many of the above are deadly to dogs, there have been limited human fatalities in the United States resulting from canine zoonotic transmission.²⁷⁶ The relatively low risk of zoonoses associated with these traditional pets likely stems from their basic biology, prolonged history living with humans, as well as more sophisticated veterinary knowledge and animal care practices.²⁷⁷

Deficiencies on the part of the USDA stem in part from data reliability issues that make tracking inspections and violations difficult.

Most regulation surrounding dog breeders relates to husbandry or licensing standards rather than systems of sale. At the federal level, USDA APHIS enforces the Animal Welfare Act (AWA) and requires licenses for those who breed more than four female dogs or cats for retail sale.²⁷⁸ However, enforcement of the AWA is lacking. These deficiencies on the part of the USDA stem in part from data reliability issues that make tracking inspections and violations difficult. Often, there is no consistent

follow-up to complaints, leading to breeders operating illegally without a license or oversight.²⁷⁹ A 2021 investigation by USDA's Office of Inspector General (OIG) found that the USDA has not been able to adequately inspect and enforce AWA standards. And since the USDA removed its animal care policy manual from its website in 2018, breeders no longer have easy access to guidelines and requirements.²⁸⁰

Furthermore, the USDA's reach is limited, as it does not regulate most breeders who sell directly to the public on site.²⁸¹ There are a range of state laws governing breeding standards including how old puppies must be before they can be sold. California, Maryland, Maine, Washington, Illinois, and over 400 local municipalities have passed bans on the sale of dogs from breeders through retail pet stores.²⁸²

274. J.K. Reaser, E. E. Clark Jr and N. M. Meyers, "All Creatures Great and Minute: A Public Policy Primer for Companion Animal Zoonoses," *Zoonoses and Public Health* 55, No. 8-10 (October 2008): 385-401.

275. Patti Strand, "It's Now or Never: Stop Dog Trafficking Now!" *National Animal Interest Alliance*, July 30, 2019, <https://www.naiaonline.org/articles/article/its-now-or-never-help-stop-dog-trafficking-now#sthash.ouawnL57.dpbs>.

276. J.K. Reaser, E. E. Clark Jr and N. M. Meyers, "All Creatures Great and Minute: A Public Policy Primer for Companion Animal Zoonoses," *Zoonoses and Public Health* 55, No. 8-10 (October 2008): 385-401.

277. J.K. Reaser, E. E. Clark Jr and N. M. Meyers, "All Creatures Great and Minute: A Public Policy Primer for Companion Animal Zoonoses," *Zoonoses and Public Health* 55, No. 8-10 (October 2008): 385-401.

278. "Retail Pet Store Rule and Importation of Live Dogs Rule –Guidance for Breeders, Brokers and Importers," *USDA APHIS*, accessed May 23, 2022, https://www.aphis.usda.gov/animal_welfare/downloads/retail-pet-store-guidance.pdf.

279. "Animal Care Program Oversight of Dog Breeders," *Office of Inspector General*, USDA, Audit Report 33601-0002-31, June 2021, https://www.usda.gov/sites/default/files/audit-reports/33601-0002-31_final_distribution.pdf.

280. Rachel Fobar, "USDA Accused of Ignoring Animal Welfare Violations in Favor of Business Interests," *National Geographic*, October 13, 2021, <https://www.nationalgeographic.com/animals/article/usda-accused-of-ignoring-animal-welfare-for-business-interests>.

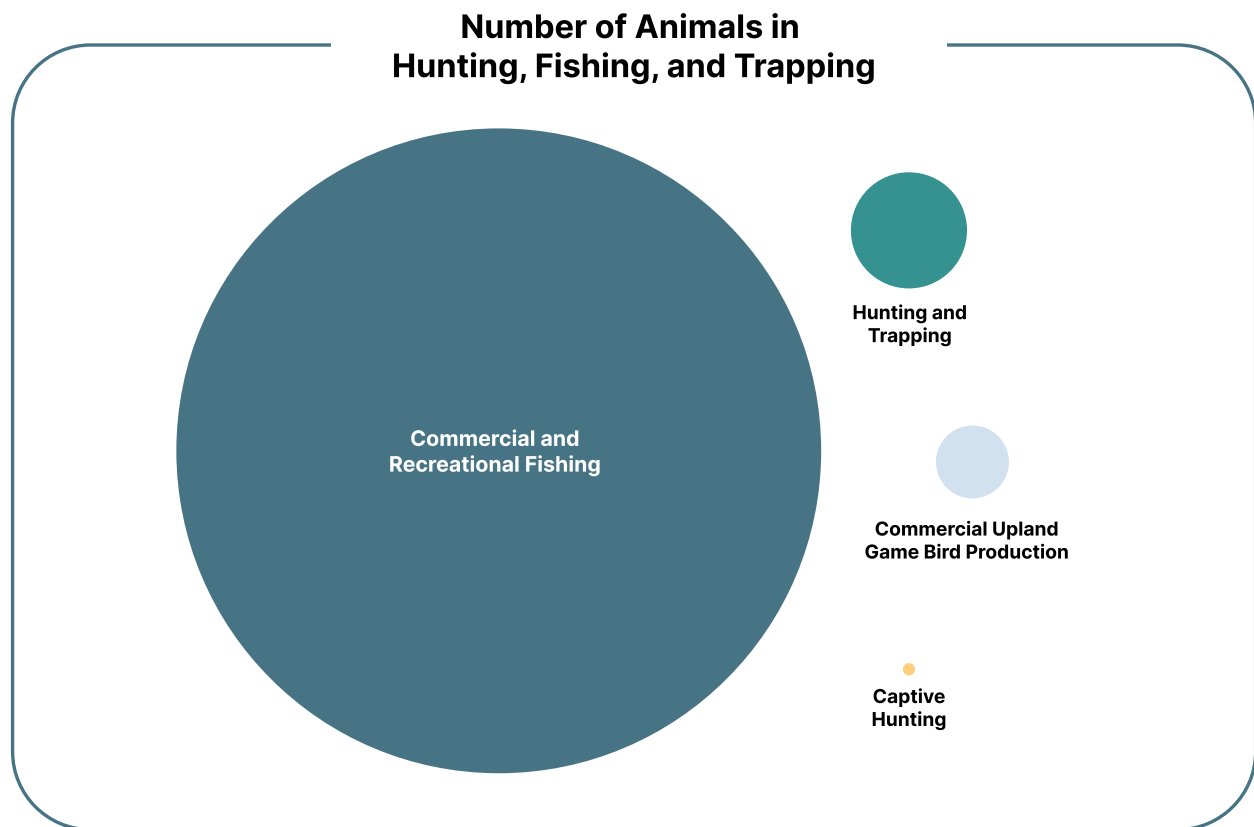
281. "What Are the Regulations Surrounding Commercial Dog Breeding?" *AskUSDA*, last updated June 10, 2022, <https://ask.usda.gov/s/article/What-are-the-regulations-surrounding-commercial-dog-breeding>.

282. "Pet Shops and Puppy Mills," *MSPCA-Angell*, accessed May 31, 2023, https://www.mspca.org/animal_protection/pet-shops-and-puppy-mills-3/.



Hunting, Fishing, and Trapping

Hunting, fishing, and trapping take place on both public and private lands inside the United States. Most animals involved are native, free-roaming wildlife; however, they can also include captive native wildlife (such as fenced-in antelope or deer) and captive exotics (such as Arabian oryx). Both hunting and fishing can occur across the spectrum of captivity. Some activities such as trapping are executed primarily for commercial reasons while others, such as captive hunting (hunting game in confined areas), are undertaken for recreation or entertainment. Similarly, some animals are consumed and others are killed for trophies. This section includes discussions of hunting and trapping, captive hunting, and commercial and recreational fishing markets.



- Commercial and Recreational Fishing, 3.4 billion animals
- Hunting and Trapping, 104 million animals
- Commercial Upland Bird Production, 40 million animals
- Captive Hunting, 1 million animals

5. Hunting and Trapping

As a whole, the hunting and trapping industry is valued at just under \$1 billion. An estimated 3.5% of Americans, 11.5 million people, take part in hunts each year.^{283 284} Of this group, nine out of 10 hunters are male; most are middle- to high-income, and 97% are white.²⁸⁵ A wide range of species is hunted and trapped in the United States, including bison, elk, rabbits, bears, raccoons, pheasants, groundhogs, coyotes, foxes, snakes, and alligators, with deer and duck hunting being the most popular. Only 16%–35% of hunters hunt primarily for food; the rest do so predominantly for trophies or entertainment.^{286 287} Still, hunters bring home over 815 million pounds of wild venison meat (also known as “game,” “wild meat,” or “bushmeat”) each year and more than a billion pounds of meat in total.^{288 289 290 291}



Hunting occurs on both private and public lands. Roughly 40% of U.S. land is publicly owned and managed by the Department of Interior along with the states.²⁹² Of these areas, roughly three-quarters are open for hunting, including 220 million acres of federal land managed by the Bureau of Land Management.^{293 294} Most Americans, though, choose to hunt on private land.²⁹⁵ Commercial operations, such as private hunting ranches, offer a more concentrated supply of animals and associated services

283. This percentage is less than half of what it was 50 years ago, and this decline is expected to continue. Nathan Rott, “Decline in Hunters Threatens How U.S. Pays For Conservation,” *NPR*, March 18, 2018, <https://www.npr.org/2018/03/20/593001800/decline-in-hunters-threatens-how-u-s-pays-for-conservation>.

284. “2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation,” *U.S. Fish and Wildlife Service*, April 2018, <https://www.census.gov/content/dam/Census/library/publications/2018/demo/fhw16-nat.pdf>.

285. “2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation,” *U.S. Fish and Wildlife Service*, April 2018, <https://www.census.gov/content/dam/Census/library/publications/2018/demo/fhw16-nat.pdf>.

286. “The Future of Hunting and the Shooting Sports: Research-Based Recruitment and Retention Strategies,” *Responsive Management/National Shooting Sports Foundation*, Produced for the U.S. Fish and Wildlife Service under Grant Agreement CT-M-6-0, 2008, https://responsivemanagement.com/wp-content/uploads/2018/11/Future_Hunting_Shooting_Report.pdf.

287. “Exploring Recent Increases in Hunting and Fishing Participation,” *Responsive Management/American Sportfishing Association/Oregon Department of Fish and Wildlife*, Produced for the U.S. Fish and Wildlife Service under Multi-State Conservation Grant F12AP00142, 2013, https://asafishing.org/uploads/Hunting_and_Fishing_Participation_Report_2013.pdf.

288. Frank Miniter, “Why Donating Venison Matters,” *American Hunter*, July 28, 2019, <https://www.americanhunter.org/articles/2018/7/28/why-donating-venison-matters>.

289. “Wild Harvest Initiative Quarterly Update,” *Conservation Visions*, December 2019, https://www.conservationvisions.com/sites/default/files/WHI-QuarterlyUpdates/whi_quarterly_report_december_2019.pdf.

290. Jackie Holbrook, “State-by-State Hunting Data,” *Archery Trade Association*, accessed May 11, 2023, <https://archerytrade.org/state-by-state-hunting-data/>.

291. Jamie Johnson, Benjamin Zamzow, Nathan Taylor, and Matthew Moran, “Reported U.S. Wild Game Consumption and Greenhouse Gas Emissions Savings,” *Human Dimensions of Wildlife* 26, No. 1 (2021): <https://doi.org/10.1080/10871209.2020.1799266>.

292. Ray Rasker, “Public Land Ownership in the United States,” *Headwaters Economics*, July 2019, <https://headwaterseconomics.org/public-lands/protected-lands/public-land-ownership-in-the-us/>.

293. “Everything You Need to Know About Hunting on Public Lands,” *U.S. Dept Of Interior*, September 1, 2017, <https://www.doi.gov/blog/everything-you-need-know-about-hunting-public-lands>.

294. “Total Public Hunting Land Acres Available by State for USFS, BLM & State Owned Lands,” *Back Country Chronicles*, accessed May 23, 2022, <https://www.backcountrychronicles.com/public-hunting-land/>.

295. Delwin E. Benson, “Wildlife and Recreation Management on Private Lands in the United States,” *Wildlife Society Bulletin* (1973-2006) 29, No. 1 (2001): 359–71, <http://www.jstor.org/stable/3784021>.

such as lodging, meals, and guided hunts, which can cost thousands of dollars per day.²⁹⁶

In the United States, most hunters kill animals with guns or bows. Sometimes dogs are also used. Hunters often field dress the animals at the site of the kill, a process that includes removing the animal's organs, which helps to lighten and cool the carcass in order to preserve the meat and reduce bacterial growth, while also making it easier to transport. However, field dressing, which requires close contact with blood, saliva and other bodily fluids as well as entrails presents significant opportunities for disease exposure. This is particularly true in cases where hunters do not use gloves while handling the carcass, but even when they do, transmission can occur in other ways or through cuts which are common. For example, the CDC identified a previously unknown parapoxvirus in deer hunters from Virginia who nicked their fingers with a knife while field-dressing a white-tailed deer.²⁹⁷ The kinds of intensive pathogen exposures that occur during this process make hunters "more likely to become infected with uncommon zoonotic infectious diseases."²⁹⁸

Where field dressing is not allowed and the aforementioned commercial operations are not assisting, the hunter must drag the dead animal out through sheer force if it is not possible to drive a motor vehicle to the site. Sometimes this is done with the help of a team, a game cart, or a strap-on winch.²⁹⁹ Many hunters bring the carcass home and butcher the animal themselves into meal-sized portions, providing meat at a relatively low cost. Others employ local butchers to prepare the meat. Private game reserves, which require a fee or membership dues, often supply these services on property or have established partnerships with local butchers and tanners.

The trapping industry consists of individuals who trap animals for their fur, commonly called "pelts." Trapping spans a wide range of species, including animals such as red squirrels, bobcats, rabbits, mink, raccoons, mountain lions, skunks, otters, beavers, badgers, opossums, coyotes, and red foxes.³⁰⁰ Traps also capture "non-target" species such as moose, eagles, cats, and dogs, as well as endangered animals and, occasionally, humans.³⁰¹ Trap types vary from snare traps to body gripping traps to steel-jawed leghold traps. While some are designed to kill the animal, others, such as steel-jawed leghold traps, are meant only to restrain them until the trapper returns or the animal succumbs to injury or dehydration.³⁰²



296. Vermejo Park Ranch Website, (2019), accessed May 31, 2023, <https://tedturnerreserves.com/vermejo/>.

297. Amira A. Roess, Anjela Galan, Edward Kitces, Yu Li, et al., "Novel Deer-Associated Parapoxvirus Infection in Deer Hunters," *N Engl J Med* 363 (2010): 2621-2627 doi: 10.1056/NEJMoa1007407.

298. Amira A. Roess, Anjela Galan, Edward Kitces, Yu Li, et al., "Novel Deer-Associated Parapoxvirus Infection in Deer Hunters," *N Engl J Med* 363 (2010): 2621-2627 doi: 10.1056/NEJMoa1007407.

299. Tony Hansen, "9 Hard Truths About Hunting on Public Land," *Outdoor Life*, July 19, 2019, <https://www.outdoorlife.com/hard-truths-about-hunting-on-public-land/>.

300. These trappers are considered separate from fur farms; trappers and fur farms together produce over nine million pelts annually. Toby Walrath, "The Fur Trade: The Journey from Trap to Market," *Outdoor Life*, Feb 18, 2016, <https://www.outdoorlife.com/articles/hunting/2016/02/fur-trade-journey-trap-market/>.

301. Zack Strong, "Idaho Numbers Remind Us that Traps Don't Discriminate," *NRDC*, February 26, 2013, <https://www.nrdc.org/experts/zack-strong/idaho-numbers-remind-us-traps-dont-discriminate>.

302. These traps are banned in countries including Norway and China. "Laws on Leg-Hold Animal Traps Around the World," *The Law Library of Congress*, Global Legal Research Directorate, LL File No. 2016-013806, LRA-D-PUB-002405, August 2016, <https://tile.loc.gov/storage-services/service/ll/lglrd/2016479005/2016479005.pdf>.

This style of trap may present the greatest risk of disease transmission as trappers come into close contact with weak and injured live animals. The number one consumer in the world of leghold traps is the U.S. government.³⁰³ State-published leg-hold trapping manuals suggest methods of killing such as beating the animals to death or standing on their chests to suffocate them.³⁰⁴

WILDLIFE SERVICES

Wildlife Services, a division of the USDA, has killed roughly 35 million wild animals in the last decade, largely in the name of protecting livestock, crops, and big game.³⁰⁵ This agency operates in relative obscurity, with limited oversight from Congress or the American public.³⁰⁶ Wildlife Services relies on trapping, shooting, poisoning, and the use of explosives to kill the animals such as foxes, owls, black bears, badgers, mountain lions, and raccoons in large numbers.^{307 308 309 310 311 312} One common tool used by Wildlife Services is the leg-hold trap. These traps are banned in over 80 countries from Norway to China, while the U.S. government remains the largest consumer of leghold traps in the world.^{313 314} Leg-hold traps are not intended to be lethal but instead clamp onto an animal and hold them alive until the trapper returns or the animal dies of dehydration, starvation, exposure, or blood loss. This mechanism exposes personnel to wounded wild animals and their bodily fluids, which can carry zoonotic pathogens.³¹⁵ In addition, the indiscriminate nature of trapping means that Wildlife Services frequently captures non-target species. In cases where the non-target animal is still alive, operators may be exposed to risk while releasing injured animals.

Continued on next page.

303. "Ending the Use of Cruel Traps," *Project Coyote*, accessed May 23, 2022, <https://projectcoyote.org/programs/carnivore-conservation-coexistence/ending-the-use-of-cruel-traps/>.
304. Though gunshots are undoubtedly the fastest and most humane method for killing, many trappers do not want to degrade the value of the animal's pelt by piercing it with a bullet. "Trapper Ed Manual," Ohio Department of Natural Resources, accessed May 31, 2023, <https://ohiodnr.gov/static/documents/wildlife/hunting-trapping/trapper%20ed%20manual.pdf>.
305. Todd Wilkinson, "Dog's Death Spotlights Use of Cyanide 'Bombs' to Kill Predators," *National Geographic*, April 20, 2017, <https://www.nationalgeographic.com/animals/article/wildlife-watch-wildlife-services-cyanide-idaho-predator-control>.
306. Congressman Peter DeFazio, who served on the Homeland Security Committee for more than a decade, has suggested, "Wildlife Services... is more opaque than some of our intelligence agencies" describing it as a "rogue" agency that runs itself. The agency has been reported to refuse Congressional requests for accounts for their spending. Jeremy Tobias, "The Secretive Government Agency Planting 'Cyanide Bombs' Across the US," *The Guardian*, June 26, 2020, <https://www.theguardian.com/environment/2020/jun/26/cyanide-bombs-wildfire-services-idaho>.
307. Wildlife Services has also received citations from the EPA for violating laws on the use of pesticides, including some for placing explosive devices that release sodium cyanide, known as M-44s or "cyanide bombs," within 50 feet of walking paths or roadways. The division is reported to use 17 different poisons, including Sodium Cyanide which is used in M-44 spring-propelled cartridges. (Wildlife Serves employs the use of roughly 30,000 M-44s per year.) It is estimated that for every one target animal that is killed, two additional non-target animals are killed. Since 1987, at least 18 employees and several members of the public have been exposed to cyanide from triggered spring loaded traps, while an estimated 1,100 dogs have been killed by M-44s from 2000-2012. Jeremy Tobias, "The Secretive Government Agency Planting 'Cyanide Bombs' Across the US," *The Guardian*, June 26, 2020, <https://www.theguardian.com/environment/2020/jun/26/cyanide-bombs-wildfire-services-idaho>.
308. Todd Wilkinson, "Dog's Death Spotlights Use of Cyanide 'Bombs' to Kill Predators," *National Geographic*, April 20, 2017, <https://www.nationalgeographic.com/animals/article/wildlife-watch-wildlife-services-cyanide-idaho-predator-control>.
309. Mark Chalfant and David Janik, "Notice of Warning," *United States Environmental Protection Agency*, March 20, 2008, https://peer.org/wp-content/uploads/attachments/08_2_6_epa_citation.pdf.
310. Racheal Bale, "This Government Program's Job Is to Kill Wildlife," *National Geographic*, February 12, 2016, <https://www.nationalgeographic.com/animals/article/160212-Wildlife-Services-predator-control-livestock-trapping-hunting>.
311. A whistleblower, interviewed by Harper's Magazine, filed a complaint alleging some supervisors would help employees cheat on their tests to get certified to use poison in the field. Christopher Ketcham, "The Rogue Agency: A USDA Program That Tortures Dogs and Kills Endangered Species," *Harper's Magazine*, March 2016, <https://harpers.org/archive/2016/03/the-rogue-agency/>.
312. Wildlife Services Directives," *USDA Animal and Plant Health Inspection Service*, last modified June 2, 2020, https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_ws_program_directives.
313. Staff of the Global Legal Research Directorate, "Laws on Leg-Hold Animal Traps Around the World," *The Law Library of Congress*, Global Legal Research Directorate, LL File No. 2016-013806 LRA-D-PUB-002405 (August 2016): <https://tile.loc.gov/storage-services/service/l1/lglrd/2016479005/2016479005.pdf>.
314. "Ending the Use of Cruel Traps," *Project Coyote*, accessed May 27, 2022, <https://projectcoyote.org/programs/carnivore-conservation-coexistence/ending-the-use-of-cruel-traps/>.
315. "Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by USDA-APHIS-Wildlife Services: Chapter IV The Use of Foothold Traps in Wildlife Damage Management," *USDA-APHIS-Wildlife Services*, February 2019, https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/4-foothold-trap-peer-reviewed.pdf.

WILDLIFE SERVICES (Continued)

Disposing of millions of wildlife carcasses a year also poses a significant zoonotic risk. While Agency guidelines require the use of gloves when handling carcasses, they do not require masks or other forms of PPE.³¹⁶ Several aspects of the disposal process leave open opportunities for disease transmission from wildlife to humans. For example, manuals instruct operators to begin by “lightly touch[ing] the cornea of the animal’s eye” to ensure that it is dead.³¹⁷ The USDA seems aware of the risks created, providing Wildlife Service employees with a Physician’s Alert Card which “identifies a number of the more significant zoonotic diseases that personnel are likely to encounter.”³¹⁸

According to agency policy, “furs, animal parts, or edible meat may be donated, salvaged, sold or transferred.”³¹⁹ Agency directives require that, “attempts should be made to donate edible animals to charitable institutions, public agencies, handicapped or senior citizens, or other needy individuals/groups,” though at the same time noting, “WS personnel are not authorized to certify any edible wild meat as disease free.”³²⁰ Except in rare cases, no disease testing is performed on carcasses.

Apart from those used for rendering and human consumption, carcasses are generally disposed of by being “discarded or buried on the property where they were killed or recovered, or deposited on another cooperators property.”³²¹ Casual surface burial and other techniques employed can allow pathogens to linger in the environment and potentially seep into groundwater supplies or infect scavenging animals.³²² This is of particular concern with respect to prion diseases and others which can persist in the environment for months or years.³²³ Wildlife Services receives roughly \$120 million in federal funding, about twice the total amount allocated to enforcing wildlife laws and regulating wildlife trade.^{324 325 326 327 328}

Roughly four to seven million animals are killed by trappers in the United States each year—more than in any other country in the world.³²⁹ Individual fur trappers usually handle the full production process of trapping, killing, skinning, processing, and selling the animal. Some trappers sell their animal products to garment manufacturers, often overseas in Asia, while some keep the pelts for personal use.

Private trappers can also sell their pelts as well as skulls, various body parts, and full carcasses to larger fur auctions, often sponsored by private commercial dealers, some of which hold auctions across as many as 25 states. Hundreds or thousands of such items are displayed at large in-person

316. Stephen M. Vantassel and Mark A. King, “Wildlife Carcass Disposal,” *U.S. Department of Agriculture Animal & Plant Health Inspection Service Wildlife Services*, July 2018, https://www.aphis.usda.gov/wildlife_damage/reports/Wildlife%20Damage%20Management%20Technical%20Series/Carcass-Disposal-WDM-Technical-Series.pdf.
317. Stephen M. Vantassel and Mark A. King, “Wildlife Carcass Disposal,” *U.S. Department of Agriculture Animal & Plant Health Inspection Service Wildlife Services*, July 2018, https://www.aphis.usda.gov/wildlife_damage/reports/Wildlife%20Damage%20Management%20Technical%20Series/Carcass-Disposal-WDM-Technical-Series.pdf.
318. “WS Directive,” *USDA APHIS*, 2.635, April 29, 2009, https://www.aphis.usda.gov/wildlife_damage/directives/pdf/2.635.pdf.
319. “WS Directive,” *USDA APHIS*, 2.635, April 29, 2009, https://www.aphis.usda.gov/wildlife_damage/directives/pdf/2.635.pdf.
320. “WS Directive,” *USDA APHIS*, 2.635, April 29, 2009, https://www.aphis.usda.gov/wildlife_damage/directives/pdf/2.635.pdf.
321. “WS Directive,” *USDA APHIS*, 2.635, April 29, 2009, https://www.aphis.usda.gov/wildlife_damage/directives/pdf/2.635.pdf.
322. Ha Kyung Joung, Sang Ha Han, Su-Jung Park, Weon-Hwa Jheong, et al., “Nationwide Surveillance for Pathogenic Microorganisms in Groundwater near Carcass Burials Constructed in South Korea in 2010,” *Int J Environ Res Public Health* 10, No. 12 (December 2013): 7126–7143.
323. Samuel E Saunders, Shannon L Bartelt-Hunt, and Jason C Bartz, “Prions in the Environment,” *Prion* 2, No. 4 (Oct-Dec 2008): doi: 10.4161/pri.2.4.7951.
324. In addition, the agency is also paid by private parties who contract with wildlife services to remove wildlife from their land. Because Wildlife Services is not subject to the same laws that govern private citizens, this process allows individuals to circumvent environmental laws. In some cases, the federal government spends millions of dollars to preserve endangered species and, at the same time, gives Wildlife Services license to kill these same animals. Rachel Bale, “This Government Program’s Job Is to Kill Wildlife,” *National Geographic*, February 12, 2016, <https://www.nationalgeographic.com/animals/article/160212-Wildlife-Services-predator-control-livestock-trapping-hunting>.
325. Jeremy Tobias, “The Secretive Government Agency Planting ‘Cyanide Bombs’ Across the US,” *The Guardian*, June 26, 202, <https://www.theguardian.com/environment/2020/jun/26/cyanide-bombs-wildfire-services-idaho>.
326. “Budget Justifications and Performance Information Fiscal Year 2021,” *Department of the Interior Fish and Wildlife Service*, accessed May 31, 2023, <https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-budget-justification-fws.pdf>.
327. Todd Wilkinson, “Dog’s Death Spotlights Use of Cyanide ‘Bombs’ to Kill Predators,” *National Geographic*, April 20, 2017, <https://www.nationalgeographic.com/animals/article/wildlife-watch-wildlife-services-cyanide-idaho-predator-control>.
328. “Budget Justifications and Performance Information Fiscal Year 2021,” *Department of the Interior Fish and Wildlife Service*, accessed May 31, 2023, <https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-budget-justification-fws.pdf>.
329. The United States, Canada, and Russia are the three largest nations in terms of trapping. However, the precise number of animals taken through trapping each year is not known as no official estimates exist. Unlike Canada, which publishes government data on trapping, the U.S. federal government and many states do not require trappers to report how many animals they kill. Such data deficiencies make regulating the practice all the more difficult and threaten conservation efforts. “Trapping and Penning,” Animal Welfare Institute, accessed May 23, 2022, <https://awionline.org/content/trapping-and-penning>.

auctions, such as the Western States Fur Auction, in Livingston Montana, where purchasers can peruse piles of animal parts and pelts laid out on tables.³³⁰ Online fur auctions serve as another outlet for sales.³³¹ Using an online platform, bidders and sellers can purchase and prepare for sale any pelts or carcasses of animals such as foxes, mountain lions, bears, beavers, martins, bobcats, muskrats, otters and coyotes.³³² However, most of the zoonotic risk associated with the trapping industry lies earlier on in the supply chain when animals are killed, cleaned, and skinned, before being shipped through the mail or delivered to auction.

Pathogens can be contracted from live or recently deceased animals. Both hunting and trapping require direct human contact with wild animals who were recently killed or injured. This contact can include direct exposure to bodily fluids such as blood, cerebrospinal fluid, and saliva. There are a number of discrete potential animal-human touch points along the hunting and trapping process, such as being bitten or scratched by an animal caught in a trap or handling fresh carcasses, each of which creates

manifold opportunities for zoonotic transmission. These risks may be augmented by the timing of hunting seasons, which often occur during seasonal migrations, a time when healthy animals may come into contact with weak or diseased animals.³³³ In addition, hunters sometimes install wildlife feeders to attract and concentrate animals in artificially high numbers, further creating the conditions that can facilitate disease spread between animals.

Studies have shown that many hunters are uninformed about zoonotic risks and take few precautions to mitigate them. For example, only 16% of duck hunters wear gloves when handling and defeathering dead birds.³³⁴ Yet, wild aquatic birds, the natural reservoirs for avian influenza, have transmitted low pathogenic strains of virus to hunters.^{335 336} If more deadly high pathogenic strains of the virus were introduced in North America, the risk for human exposure to the virus through hunting could be substantial.³³⁷

Dozens of other zoonoses are present in hunted species throughout the United States including rabies viral disease,

Many hunters are uninformed about zoonotic risks and take few precautions to mitigate them.



330. "Western States Fur Auction," *Montana Trappers Association*, accessed May 25, 2023 <https://www.montanatrappers.org/wsfa.html>.

331. In Idaho, for example, an annual online fur auction offers furs, hides, antlers, whole carcasses, skulls, and other animal body parts (some of which have been seized by Idaho Fish and Game). Buyers provide a valid email and credit card for bidding approval; a Taxidermist-Fur Buyer license is needed to purchase raw skins or parts of bears, mountain lions, wolves, or any raw hide, skin or pelt. Winning bidders pick up their animal parts at Idaho Fish and Game's regional office. "Annual F&G Fur Auction Online in 2023, begins April 10," Idaho Fish and Game, March 24, 2023, <https://idfg.idaho.gov/article/annual-fg-fur-auction-online-2023-begins-april-10>.

332. Wears Auctioneering Website, accessed May 25, 2023, www.wearswest.com.

333. Alexa Fritzsche McKay and Bethany J. Hoyer, "Are Migratory Animals Superspreaders of Infection?" *Integrative and Comparative Biology* 56, No. 2 (August 2016): 260–267, <https://doi.org/10.1093/icb/icw054>.

334. Hope Dishman, David Stallknecht, and Dana Cole, "Duck Hunters' Perceptions of Risk for Avian Influenza, Georgia, USA," *Emerging Infectious Diseases* 16, no 8 (August 2010): 1279–1281, <https://doi.org/10.3201/eid1608.100032>.

335. James Gill, Richard Webby, Mary Gilchrist, and Gregory Gray, "Avian Influenza Among Waterfowl Hunters and Wildlife Professionals," *Emerging Infectious Diseases* 12, No. 8 (August 2006): 1284–1286, <http://dx.doi.org/10.3201/eid1208.060492>.

336. Pet ducks have also transmitted the H5N1 to humans. Nicoletta Lanese, "U.K.'s First Human Case of H5N1 Avian Flu Detected in Man with Pet Ducks," *LiveScience*, January 7, 2022, <https://www.livescience.com/uk-first-human-case-h5n1-bird-flu>.

337. James Gill, Richard Webby, Mary Gilchrist, and Gregory Gray, "Avian Influenza Among Waterfowl Hunters and Wildlife Professionals," *Emerging Infectious Diseases* 12, No. 8 (August 2006): 1284–1286, <http://dx.doi.org/10.3201/eid1208.060492>.

tularaemia, tuberculosis, and Hantavirus Pulmonary Syndrome.^{338 339 340 341} Tuberculosis, for example, is present in certain populations of white-tail deer and elk in the North Central United States, while brucellosis is found in elk and bison in the greater Yellowstone area of Montana, Wyoming, and Idaho.³⁴² More recently, the USDA found evidence of SARS-CoV-2 in free-roaming white-tailed deer and mink.^{343 344} Further research found 30% of captive and wild deer tested in Iowa in 2020 to carry SARS-CoV-2, with some groups showing infection rates of over 80%.³⁴⁵

The USDA found evidence of SARS-CoV-2 in free-roaming white-tailed deer and mink.

Another concern is Chronic Wasting Disease (CWD), a prion disease similar to mad cow disease that is 100% fatal in animals and cannot be removed by cooking.^{346 347 348} Though CWD has not been found in humans, there is some evidence suggesting that it could be transmissible or become transmissible in the future. Studies have shown CWD can infect non-human primates who eat meat from CWD-infected animals, raising concerns that there could be risks to hunters from consuming or handling CWD-infected animals.³⁴⁹ Furthermore, deer infected with CWD do not always show any visible symptoms of disease. Because of this risk, the CDC recommends testing in areas where CWD is present before consuming the meat.³⁵⁰ As of 2020, the FDA and the USDA consider meat from CWD-positive animals to be unsuitable for human or animal consumption.^{351 352} Though there is no federal testing system in place, some states such as Colorado have moved to fill this gap.

338. "Disease Precautions for Hunters," *American Veterinary Medical Association*, accessed May 23, 2022, <https://www.avma.org/resources/public-health/disease-precautions-hunters>.
339. "Diseases Associated with Hunting and Trapping," *Encyclopedia of Occupational Health and Safety*, March 25, 2021, <https://www.iloencyclopaedia.org/part-x-96841/hunting/item/796-diseases-associated-with-hunting-and-trapping>.
340. "Zoonoses Associated with Wild Ungulates," *Washington State University*, Office of the Campus Veterinarian and the IACUC, January 2021, <https://iacuc.wsu.edu/zoonoses-associated-with-wild-ungulates/>.
341. "Frequently Asked Questions: Bison," *National Park Service*, Yellowstone National Park, ID, MT, WY, last modified January 27, 2021, <https://www.nps.gov/yell/learn/nature/bisonfaq.htm>.
342. "Zoonoses Associated with Wild Ungulates," *Washington State University*, Office of the Campus Veterinarian and the IACUC, January 2021, <https://iacuc.wsu.edu/zoonoses-associated-with-wild-ungulates/>.
343. Emily Anthes and Sabrina Imbler, "Is the Coronavirus in Your Backyard?" *The New York Times*, February 7, 2022, <https://www.nytimes.com/2022/02/07/health/coronavirus-deer-animals.html>.
344. Mitchell Palmer, Mathias Martins, Shollie Falkenberg et al, "Susceptibility of White-Tailed Deer (*Odocoileus virginianus*) to SARS-CoV-2," *Journal of Virology*, 95, No. 11 (May 10, 2021): <https://doi.org/10.1128/JVI.00083-21>.
345. Suresh Kuchipudi, Meera Surendran-Nair, Rachel Rudenet et al, "Multiple Spillovers and Onward Transmission of SARS-Cov-2 in Free-Living and Captive White-tailed Deer (*Odocoileus virginianus*)," *bioRxiv*, 10.31.466677; doi: <https://doi.org/10.1101/2021.10.31.466677>.
346. Prion diseases are fatal brain diseases that occur in mammals. The disease causes normal prion proteins in the brain to reassemble into structured aggregates that cause infectious brain disease. "Prion Diseases," *National Institute of Allergy and Infectious Diseases*, last updated October 21, 2019, <https://www.niaid.nih.gov/diseases-conditions/prion-diseases>.
347. David R. Edmunds, Matthew J. Kauffman, Brant A. Schumaker, and Frederick G. Lindzey, "Chronic Wasting Disease Drives Population Decline of White-Tailed Deer," *PLOS ONE* 11, No. 8 (August 30, 2016): <https://doi.org/10.1371/journal.pone.0161127>.
348. "Advice on Eating Game," *New York State Department of Health*, last modified May 2014, https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/advice_on_eating_game.htm.
349. "Chronic Wasting Disease," *Centers for Disease Control and Prevention*, last updated September 10, 2021, <https://www.cdc.gov/prions/cwd/index.html>.
350. "Chronic Wasting Disease: Prevention," *Centers for Disease Control and Prevention*, last updated October 18, 2021, <https://www.cdc.gov/prions/cwd/prevention.html>.
351. M. Li, M.D. Schwabenlander, G.R. Rowden, "RT-QuIC Detection of CWD Prion Seeding Activity in White-Tailed Deer Muscle Tissues," *Scientific Reports* 11, No. 16759 (2021): <https://doi.org/10.1038/s41598-021-96127-8>.
352. Another growing activity in the United States is "shed hunting" or the collection of antlers, shed annually by adult male elk, moose, and deer. Velvet antlers, as they are called during their soft growth period, later ossify and the animals use trees to scrape off their velvet coating. Shed hunters collect found antlers left behind by animals, but they also sometimes harvest the antlers, or connected antlers and skull plates, from dead animals (or live ones in captive breeding facilities). In the process, they may be exposed to blood or other cerebrospinal fluids that can carry pathogens like CWD. (This is of particular concern when interacting with the animal's brain and skull.) Shed hunts are particularly popular in Wyoming where antler pairs are known to sell as high as \$1,500 and dead mounts (parts of a dead animal assembled in a natural position giving them a life-like appearance), many times more. In addition to supporting domestic demand, the United States now exports nearly three million dollars' worth of antler products, primarily to Asia. Abe Streep, "The Great American Antler Boom" *The New Yorker*, March 7, 2022, <https://www.newyorker.com/magazine/2022/03/14/the-great-american-antler-boom>.

WINTER ELK FEEDING PROGRAMS

Five states have implemented state-sponsored winter feeding programs to increase elk populations for hunting and limit elk grazing on land used for livestock production.³⁵³ Wyoming alone spends roughly \$2 million annually to feed some 22,000 elk across 22 feeding stations in the western part of the state where much of the species' historical range has been supplanted by cattle ranching.³⁵⁴ Elk at these feeding grounds are tightly packed together with up to 5,000 animals per acre in some cases. While many pathogens do not cause disease in humans, artificially aggregating wildlife in densities not found in nature allows pathogens opportunities to move rapidly through a host population with the potential to acquire beneficial mutations and generate more dangerous forms along the way. After finding that the presence of brucellosis antibodies was 13 times higher in feedground elk than elk that did not frequent the feedgrounds, the Wyoming Game and Fish Department's report concluded, "These data support the contention that feedgrounds increase the probability of disease transmission."³⁵⁵ State policymakers nevertheless continue the practice despite warnings that feedgrounds might rapidly spread new disease like CWD, which has the potential to decimate wildlife populations as it may remain infectious and bioavailable in the environment for more than two years.^{356 357} CWD was detected for the first time in feedground elk in Wyoming in 2020.³⁵⁸

Apart from federally protected species, hunting and trapping are regulated entirely at the state level. State departments of wildlife oversee 630 million acres of public lands and establish rules for hunting and fishing.³⁵⁹ Roughly 50,000 people are employed by state wildlife agencies, compared to just 8,000 federal employees at FWS.³⁶⁰

INDIGENOUS PRACTICES

Hunting and trapping is an important part of many indigenous practices in the United States, making these individuals particularly susceptible to zoonoses present in native wildlife. Tens of thousands of Indigenous Alaskans, for example, rely heavily on a diet of wild animals, such as caribou, seals, and fish. Animals are also used for shelter, fuel, clothing, tools, and transportation as well as handicrafts made from their parts.³⁶¹ The Endangered Species Act and the Marine Mammal Protection Act generally exempt Indigenous Alaskan subsistence hunting from their prohibitions.^{362 363} Tribes have worked, sometimes unsuccessfully, with federal, state, and local governments to preserve habitat and prevent overhunting and overfishing. Under existing treaties, Native Americans generally possess exclusive rights to hunt and fish across the 55 million acres of Federal Indian trust land and treaty-reserved areas.^{364 365 366}

353. Angus M. Thuerner Jr., "Game and Fish Plans for Deadly Disease at Elk Feedgrounds," *WyoFile*, December 3, 2020, <https://wyofile.com/game-and-fish-plans-for-deadly-disease-at-elk-feedgrounds/>.
354. Bruce Smith, "Elk Winter Feeding = Disease Facilitation," *The Wildlife Professional* (Winter 2013): https://www.brucesmithwildlife.com/_files/ugd/8ca9a6_b54c73e9f2024c43ba47381d2f98222d.pdf.
355. Bruce Smith, "Elk Winter Feeding = Disease Facilitation," *The Wildlife Professional* (Winter 2013): https://www.brucesmithwildlife.com/_files/ugd/8ca9a6_b54c73e9f2024c43ba47381d2f98222d.pdf.
356. Bruce Smith, "Elk Winter Feeding = Disease Facilitation," *The Wildlife Professional* (Winter 2013): https://www.brucesmithwildlife.com/_files/ugd/8ca9a6_b54c73e9f2024c43ba47381d2f98222d.pdf.
357. Alicia Otero, Camilo Velásquez, Judd Aiken et al. "Chronic Wasting Disease: A Cervid Prion Infection Looming to Spillover," *Veterinary Research* 52, No. 115 (2021): <https://doi.org/10.1186/s13567-021-00986-y>.
358. Kamila Kudelska, "First Elk Tests Positive For CWD In Northwest Wyoming," *Wyoming Public Media*, December 18, 2020, <https://www.wyomingpublicmedia.org/natural-resources-energy/2020-12-18/first-elk-tests-positive-for-cwd-in-northwest-wyoming>.
359. Larry Voyles and Loren Chase, "The State Conservation Machine," *Association of Fish & Wildlife Agencies* and the *Arizona Game and Fish Department*, 2017, https://www.fishwildlife.org/application/files/3615/1853/8699/The_State_Conservation_Machine-FINAL.pdf.
360. "FWS Leadership," *U.S. Fish and Wildlife Services*, accessed May 31, 2023, <https://www.fws.gov/about/staff>.
361. Alaska Statute §16.05.940.
362. "Permits for Native Endangered and Threatened Species," *U.S. Fish and Wildlife Service*, accessed May 31, 2023, <https://www.fws.gov/library/collections/permits-native-endangered-and-threatened-species>.
363. Exemptions extend to animals used for handicrafts and other purposes apart from food. Handicrafts made under these exemptions may be sold, so long as they are substantially altered. However, these exemptions have been exploited on occasion. In 2007, for example, a member of the Aleut community pled guilty to selling seal penises commercially for use in traditional Asian medicine. "Alaskan Man Pleads Guilty to Sale of Seal Penises," *Reuters*, July 13, 2007, <https://www.reuters.com/article/us-seal-penis-1/alaskan-man-pleads-guilty-to-sale-of-seal-penises-id1NKUA15360220070621>.
364. Unlike Alaskan Natives, Native American Indians are not exempt from the Endangered Species Act and cannot legally take endangered or threatened species. "Secretarial Order # 3206 Subject: American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act," *Secretary of the Interior and the Secretary of Commerce* DigitalCommons@University of Nebraska—Lincoln, June 5, 1997, <https://digitalcommons.unl.edu/lawwater/5/>.
365. In 1993, hantavirus spread among Navajo populations in the Four Corners area of the United States upon contact with hantavirus-infected rodents, particularly deer mice, or their urine and droppings. In this outbreak, 26 tribe members were infected and 13 died from the virus. Another hantavirus outbreak occurred among the Navajo tribe in 2016. Jim Robbins, "Montana Mice May Hold Secret to Virus Spillover," *NBCMontana*, February 10, 2022, <https://nbcmontana.com/news/local/montana-mice-may-hold-the-secret-to-virus-spillover>.
366. "NCEZID: Tribal Health In Action," *Centers for Disease Control and Prevention*, last modified December 22, 2017, <https://www.cdc.gov/ncezid/what-we-do/crosscutting-programs/tribal-health-in-action.html>.



Each state department of wildlife is overseen by commissions (or boards) that set agency policy.³⁶⁷ However, many states reserve a number of seats—often a majority of seats—on these commissions for consumptive users (hunters, trappers, and fishermen), while other states go so far as to prohibit any non-consumptive user from serving on the commission.³⁶⁸ For example, Mississippi law states, “All of the Commissioners shall be an active outdoorsman holding a resident hunting or fishing license in at least five (5) of the ten (10) years preceding appointment.”³⁶⁹ Estimates suggest that roughly 75% of commission seats nationwide are held by consumptive users, though hunters, for example, make up just 3%–4% of Americans.³⁷⁰ Among the general public, non-consumptive activities such as wildlife watching are far more popular. However, without representation on state wildlife boards, these perspectives are marginalized and rarely reflected in policy-making, resulting in a value gap between the public and regulators.³⁷¹ Because of the success of ballot measures, which have historically carried broad public support, limiting certain types of hunting and hunting methods, some states have moved to

further insulate the industry from public opinion by adding additional procedural hurdles that either stop ballot measures from taking effect or to prevent hunting and trapping from being regulated through public initiatives altogether.³⁷²

State wildlife agencies are funded in part by tax revenue from the sale of hunting equipment. They also both issue and are funded by the sale of hunting licenses, which in some states account for 60% of their annual budget.^{373 374 375} Unlike other administrative agencies, such as departments of public health, this structure ensures that regulators are financially dependent on those whom they regulate. In some states, wildlife agencies receive no general funding, meaning they are almost wholly reliant on the “sale” of wildlife.³⁷⁶ The result is something more akin to a traditional private-sector business model whereby state agencies, responsible for issuing the licenses, spend time and money marketing to recruit new hunters and provide industry supporting programs, such as training, game

367. These boards often control budget, rule-making, and leadership decisions as well. They range in size from four to nineteen members, typically appointed by the governor.

368. Consumptive uses are those in which the animal is killed. By contrast, non-consumptive uses, such as wildlife watching, are those wildlife related activities that do not involve lethal measures. Bruce Rocheleau, *Wildlife Politics*, New York: Cambridge University Press, 2017.

369. Mississippi Code Title 49. Conservation and Ecology § 49-4-4.

370. “2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation,” *U.S. Fish and Wildlife Service*, October 2018, <https://www.census.gov/content/dam/Census/library/publications/2018/demo/fhw16-nat.pdf>.

371. State wildlife employees tend not to be reflective of the broader public in other ways as well: They are 91% white and 73% male. Michael Manfredo, Tara Teel, and Alia Dietsch, “America’s Wildlife Values: The Social Context of Wildlife Management in the U.S.,” report from the research project “America’s Wildlife Values,” *Colorado State University*, Department of Human Dimensions of Natural Resources, 2018. <https://sites.warnercnr.colostate.edu/wildlifevalues/wp-content/uploads/sites/124/2019/01/AWV-National-Final-Report.pdf>.

372. Tyler Welch, “Can Citizens Better Use the Ballot Initiative to Protect Wildlife?: The Case of the Mountain Lion in the West,” *Colo. Nat. Resources, Energy & Env’tl. L. Rev.* 25, No. 2, <https://www.colorado.edu/law/sites/default/files/Welch%2025-2.pdf>.

373. Nathan Rott, “Decline In Hunters Threatens How U.S. Pays For Conservation,” *NPR*, March 20, 2018, <https://www.npr.org/2018/03/20/593001800/decline-in-hunters-threatens-how-u-s-pays-for-conservation>.

374. By contrast, an estimated 94% federal and non-profit funding to support wildlife conservation comes from non-hunters. Mark Smith and Donald Molde, “Wildlife Conservation and Management in the U.S.,” *Nevadans for Responsible Wildlife Management*, October 2014, <https://wolfwatcher.org/wp-content/uploads/2013/05/Who-Pays-Wildlife-Conversation-and-Management-Funding-in-the-US.pdf>.

375. Larry Voyles and Loren Chase, “The State Conservation Machine,” *Association of Fish & Wildlife Agencies and the Arizona Game and Fish Department*, 2017, https://www.fishwildlife.org/application/files/3615/1853/8699/The_State_Conservation_Machine-FINAL.pdf.

376. Dean Lueck, “An Economic Guide to State Wildlife Management,” *State Wildlife Management PERC Research Study* RS 00-2, https://www.perc.org/wp-content/uploads/old/rs00_2.pdf.

farming, and state-sponsored bounties on carnivores.³⁷⁷ Because of this structure, states have little incentive to impose sanitary or public health related regulations on hunters that may negatively affect license sales.

STATE-SPONSORED BOUNTY PROGRAMS

State-sponsored bounty programs exist across much of the country in order to secure additional funding for state wildlife agencies. Predator reduction leads to overpopulation of prey species which, in turn, drives the sale of more hunting licenses and increased bag limits. However, these programs also incentivize direct contact with dead or injured animals through the hunting and trapping process. In order to collect the financial reward, hunters must kill and transport some portion of the carcass to redeem for payment—a scalp, or foot, or tail. This process sometimes requires contact with blood and entrails of species types that are high-risk carriers of zoonotic disease and may also lead to improper disposal of the remainder of the carcass.^{378 379} Recent bounty programs include Idaho’s wolf bounty that paid \$1,000 per dead animal or Utah’s program that paid \$50 per coyote scalp; in a single year, the Utah program paid out more than \$500,000 for 11,000 coyotes.^{380 381} South Dakota compensates hunters for killing a wide range of species that may prey on the eggs of waterfowl in order to increase bird populations for hunting. Here, hunters can be compensated for killing raccoons, striped skunks, badgers, opossums, and red foxes. In the last two years of this program, 4,300 people participated and killed 81,000 animals, many of them rabies vector species.³⁸²

There is some evidence that these incentives trickle down to color scientific recommendations as well. For example, scientists working for state wildlife agencies were three times more likely to recommend removing protections for grizzly bears than independent scientists employed at universities.³⁸³ The study’s authors noted that, “Scientists who work for governmental agencies can face strong ‘top down’ pressure from within their organizations... to reach particular decisions.”³⁸⁴ These forces culminate in a regulatory system that is strongly predisposed in favor of consumptive wildlife activities, while doing relatively little to support non-game species.³⁸⁵ This approach can undermine ecosystem health and biodiversity, which heightens the risk of zoonotic disease.³⁸⁶

States require hunters and trappers to obtain licenses to hunt on public or private land. However, there are broad exceptions to this rule.³⁸⁷ Various other restrictions apply that dictate when,

377. Each March, in Sweetwater, TX rattlesnakes are trapped and collected from their dens in the wild (often by gassing) for an event known as the Sweetwater Rattlesnake Roundup, in which the animals are put on display for crowds and skinned for leather. While there are similar smaller events, the Sweetwater Rattlesnake Roundup is the largest, drawing over 40,000 spectators a year who watch as 3,500 to 4,000 pounds of rattlesnakes which are weighed, milked for venom, and used in killing contests. After the animals are killed and skinned by participants, some of whom sign their names next to handprints left in blood, the snakes are often rolled in batter and deep fried for sale and consumption. This event and others like it combine large numbers of people and large numbers of wild animals in an enclosed space; they are also marked by the kinds of high-risk human-animal interactions, such as slaughter and skinning, that can facilitate disease transmission.
378. Domenico Otranto and Peter Deplazes, “Zoonotic Nematodes of Wild Carnivores,” *International Journal for Parasitology: Parasites and Wildlife* 9 (August 2019): 370–383. <https://doi.org/10.1016/j.ijppaw.2018.12.011>.
379. Barbara Han, Andrew Kramer, and John Drake, “Global Patterns of Zoonotic Disease in Mammals,” *Trends in Parasitology* 32, No. 7 (June 14, 2016): 565–577, <https://doi.org/10.1016/j.pt.2016.04.007>.
380. Amanda Peacher, “State Of Idaho Funds Controversial Wolf Bounty Program,” *Colorado Public Radio*, April 9, 2019, <https://www.cpr.org/2019/04/09/state-of-idaho-funds-controversial-wolf-bounty-program/>.
381. Brody Henderson, Brody, “Wildlife Bounties: Effective Management or Relic of the Past,” *The MeatEater*, Feb 12, 2019, <https://www.themeateater.com/conservation/wildlife-management/wildlife-bounties-effective-management-or-relic-of-the-past>.
382. “Nest Predator Bounty Program,” *South Dakota Game, Fish & Parks*, accessed May 31, 2023, <https://gfp.sd.gov/bounty-program/>.
383. J.T. Bruskotter, H. Szarek, G. Karns, A. Heeren, E. Toman, and R.S. Wilson, “To List or Not to List? Experts’ Judgments about Threats to Greater Yellowstone Grizzly Bears,” *The Ohio State University*, College of Food, Agriculture, and Environmental Studies, 2016, USA. <https://senr.osu.edu/sites/senr/files/imce/files/research/publications/Bruskotter%2520et%2520al%2520%25282016%2529%2520GYE%2520Grizzly%2520Report.pdf>.
384. Jeremy T. Bruskotter, John A. Vucetich, and Robyn S. Wilson, “Of Bears and Biases: Scientific Judgment and the Fate of Yellowstone’s Grizzlies,” *Associated Press*, June 21, 2016, <https://apnews.com/article/724f4ec9a42b4719aee8016b5c0c4ce4>.
385. Travis Gallo and Liba Pejchar, “Improving Habitat for Game Animals Has Mixed Consequences for Biodiversity Conservation,” *Biological Conservation* 197 (May 2016): 47–52, <https://doi.org/10.1016/j.biocon.2016.02.032>.
386. Yewande Alimi, Jonathan Epstein, Manish Kakkur, Guilherme Werneck, “Report of the Scientific Task Force on Preventing Pandemics,” *Harvard Global Health Institute*, Harvard T.H. Chan School of Public Health, August 2021, <https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/08/PreventingPandemicsAug2021.pdf>.
387. In particular, many states do not always require individuals to obtain a license if hunting on their own land. In addition, licenses are not required for hunting certain species on private lands. “Exceptions for Obtaining a License,” *North Carolina Wildlife Resources Commission*, accessed May 31, 2023, <https://www.ncwildlife.org/Licensing/Hunting-Fishing-Trapping-Licenses/exceptions-for-obtaining-a-license>.

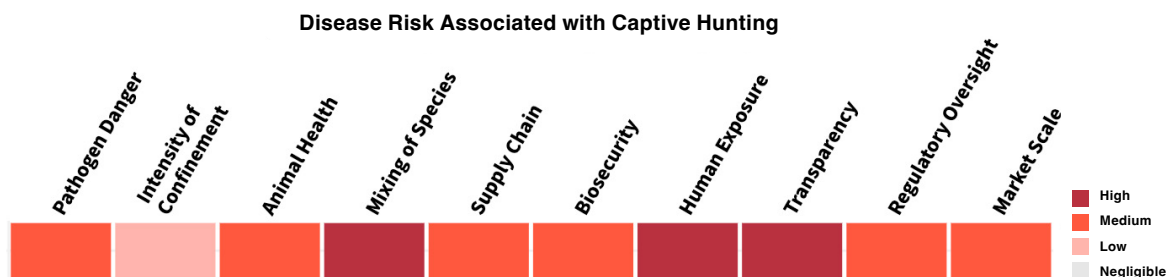
how, and how many animals may be killed. Most states require hunting education courses; these courses focus on firearm safety and other principles, but say little about disease risks. Vanishingly few state regulations governing hunting are grounded in public health.³⁸⁸ For example, states do not impose sanitary requirements on hunters, such as requiring the use of gloves, other personal protective equipment (PPE), or hand washing when handling dead animals, and do not typically regulate the disposal of carcasses.

Trapping is noticeably less regulated than hunting. Only 21 states require licensees to complete trapper education courses, and even fewer regulate how trappers kill live animals caught in their traps.^{389 390} Fewer than half of the states set quotas for trappers, and just 13 states require trappers to report the number of animals they harvest.³⁹¹³⁹² As a result, no sound data exists as to the number of animals processed through this industry and little is known about the zoonotic risk these interactions carry.

No sound data exists as to the number of animals processed through this industry and little is known about the zoonotic risk these interactions carry.

6. Captive Hunting

Captive hunting, sometimes colloquially known as “canned hunting,” is a form of a commercial hunting operation that takes place on fenced private lands in the United States where animals are hunted for a fee. Unlike traditional hunting, captive hunting facilities (sometimes also called “hunting preserves”) guarantee success while eschewing principles of “fair chase.” Captive hunting may involve native species such as white-tailed deer and elk as well as non-native exotics spanning over 130 different species such as antelope, zebra, oryx, wildebeests, and buffalo.³⁹³



388. Chronic wasting disease mitigation measures, such as those that restrict the movement of cervids from affected areas, and state testing programs are an exception to this general rule, in part, because of the threat the disease poses to deer populations and licensing revenues. “Texas Parks and Wildlife Hunting Regulations,” *Texas Parks and Wildlife*, September 1, 2021–August 31, 2022, https://tpwd.texas.gov/documents/237/pwd_bk_l2000_1170a.pdf.

389. “Trapping Regulations Survey and Best Management Practices,” *State Fish and Wildlife Agency*, accessed May 31, 2023, https://www.fishwildlife.org/application/files/5215/2123/4829/Trapping-Regulations-Survey-FINAL-03-06-18_reduced.pdf.

390. “Nationwide Trapping Dispatch and Release Regulations,” *Colorado Parks and Wildlife*, accessed May 27, 2022, [https://cpw.state.co.us/Documents/Commission/2019/July/Agenda.Item.14-Trapping.Dispatch-July.2019.PWC%20\(1\).pdf](https://cpw.state.co.us/Documents/Commission/2019/July/Agenda.Item.14-Trapping.Dispatch-July.2019.PWC%20(1).pdf).

391. “Trapping Regulations Survey and Best Management Practices,” *State Fish and Wildlife Agency*, accessed May 31, 2023, https://www.fishwildlife.org/application/files/5215/2123/4829/Trapping-Regulations-Survey-FINAL-03-06-18_reduced.pdf.

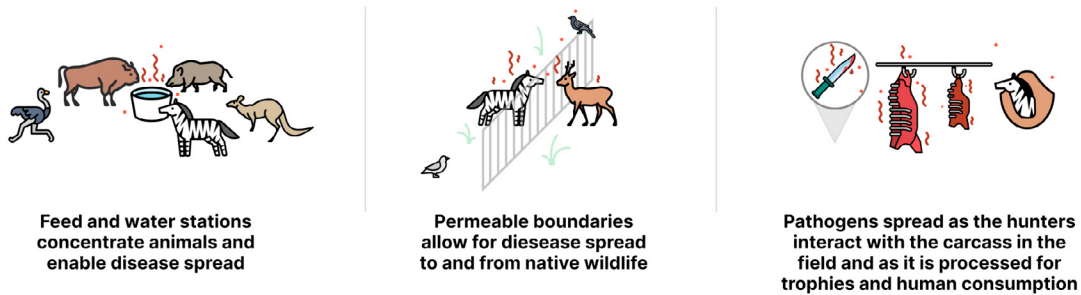
392. “Fur Trapping: What is the Issue?” *FOUR PAWS in US*, accessed May 31, 2023, <https://www.fourpawsusa.org/campaigns-topics/topics/fur/fur-trapping>.

393. David P. Anderson, Brian J. Frosch, Joe L. Outlaw, “Economic Impact of the Exotic Wildlife Industry,” *Agricultural & Food Policy Center Texas A&M University*, APFC Research Report 07-2, August, 2007, <https://www.afpc.tamu.edu/research/publications/496/rr-2007-02.pdf>.

Most animals on captive hunting reservations are bred on-site or purchased directly from exotic animal breeders (sometimes known as “game ranches”) while others are obtained through exotic animal auctions. Zoos, disposing of surplus animals, can also serve as a source. Likewise, unwanted animals from the exotic pet trade are sometimes used to stock these hunting facilities.³⁹⁴ A small set of animals is imported for this purpose as well, further complicating the supply chain. It is estimated that there are over 1,000 exotic hunting operations in the United States, with most of these located in Texas, where some four million acres are devoted to exotic animal ranches and reserves.³⁹⁵ Hunts happen both during the day and at night. Sometimes animals are shot on foot but also from roaming SUVs, ATVs, or hunting towers equipped with pool tables, poker, and alcohol as well as with motion sensors to alert patrons to the presence of an animal.

Captive hunting operations allow for the mixing of a wide range of species from different continents that would never encounter one another in nature. This interspecies contact may offer pathogens additional opportunities to spread among species and provide them new pathways to reach humans. Other conditions of captive hunting facilities also lend themselves to zoonotic transmission. For example, animals are artificially concentrated in large numbers, with both native and non-native species confined in fenced areas sharing the same feeding stations and water sources. Veterinary care is provided infrequently. The lack of biosecurity among different species of captive wildlife, between free-roaming wild animals and captive ones, and between hunters and the animals they kill each increase the risk of disease transmission.³⁹⁶

Pathways for Pathogen Transmission on a Captive Hunting Facility



Captive hunting presents zoonotic risks at a variety of animal-human touch points along the supply chain. White-tailed deer, one of the most common species on captive hunting operations, are often bred or artificially inseminated in pens at captive breeding facilities where both CWD and SARS-CoV-2 have been found.³⁹⁷ Animals are handled during the transport process as they are moved from a breeding facility to hunting ranch; sometimes they are sedated before being loaded onto a cattle trailer.³⁹⁸ Once on the hunting grounds, some animals become tame enough for people to hand feed or pet.

394. Diana Norris, Norm Phelps, and D.J. Schubert, “Canned Hunts: Unfair at Any Price,” *Michigan State University Animal Legal and Historical Center*, 2002, <https://www.animallaw.info/article/canned-hunts-unfair-any-price>.

395. “Captive Hunts Fact Sheet,” *Humane Society of the United States*, accessed May 7, 2023, <https://www.humanesociety.org/resources/captive-hunts-fact-sheet>.

396. Fences can be porous such that local wildlife, livestock, and companion animals may get in and animals within the operation may get out (these operations sometimes also have domestic animals on site or located adjacent to livestock farms).

397. Mitchell Palmer, Mathias Martins, et al., “Susceptibility of White-Tailed Deer (*Odocoileus virginianus*) to SARS-CoV-2,” *Journal of Virology* 95, No. 11 (May 10, 2021): <https://journals.asm.org/doi/10.1128/JVI.00083-21>.

398. “Deer Farming 101,” *North American Deer Farmers Association*, accessed May 31, 2023, <https://nadefa.org/2019/02/13/deer-farming-101/>.

Certain species, such as camels and giraffes, for example, are sometimes used by facilities for entertainment or as mascots, rather than for killing.³⁹⁹

Animals are typically shot with either a gun or a bow and arrow; the latter presents additional risks, as animals more often die of exsanguination (loss of blood) allowing for increased risk of disease transmission.⁴⁰⁰ And after the kill, the patron or ranch operators will field dress the animal (removing internal organs at the kill site) and transfer the carcass to a butcher or taxidermist. Many animals are processed for human consumption. In some cases, this processing may happen at local butcher shops alongside other domestic species, using the same equipment. Each of these steps in production presents opportunities for the spread of pathogens through direct contact or indirect contact, causing diseases such as tuberculosis, brucellosis, sarcoptic mange, papillomavirus, and CWD.^{401 402}

TAXIDERMISTS

Taxidermy is a surprisingly large industry in the United States that operates mostly outside of the public eye. There are over 3,200 taxidermy businesses generating roughly \$700 million in annual revenue.⁴⁰³ Taxidermists provide a service for hire for hunters looking to turn their kills into trophies. Some taxidermists also source animals to create their own mounts for sale, sometimes from pet stores, breeders, zoos, online sellers, wildlife rehabilitation centers, veterinary offices, or as roadkill. The first step in traditional taxidermy is removing the skin from the animal, so that it can be salted and preserved. In some cases, the remainder of the animal is then discarded in favor of an artificial mold. In other cases, particularly with birds, the skull and body cavities are emptied out to be filled with clay or wire framing.⁴⁰⁴ It is not uncommon for taxidermists to accidentally cut themselves during either process. The nature of these interactions—whether they are carried out by the taxidermist or in preparation for taxidermy by the hunter in the field—carries risk in terms of the potential for disease transfer.⁴⁰⁵ Some, but not all of this risk, can be mitigated by freezing the carcass. Roughly half of states require taxidermists to obtain a license.⁴⁰⁶ Licenses often cost as little as \$6 and do not require training.^{407 408}

399. Wes Ferguson, “How Texas Hunting Went Exotic,” *Texas Monthly*, February 2021, <https://www.texasmonthly.com/travel/how-texas-hunting-went-exotic/>.

400. Diana Norris, Norm Phelps, and D.J. Schubert, “Canned Hunts: Unfair at Any Price,” *Michigan State University Animal Legal and Historical Center*, 2002, <https://www.animallaw.info/article/canned-hunts-unfair-any-price>.

401. A. Sorensen, F.M. van Beest, and R.K. Brook, “Impacts of Wildlife Baiting and Supplemental Feeding on Infectious Disease Transmission Risk: A Synthesis of Knowledge,” *Preventive Veterinary Medicine* 113, No. 4 (2014): 356–63, <https://doi.org/10.1016/j.prevetmed.2013.11.010>.

402. Though CWD has not been shown to infect people, its management is still a top concern in conservation medicine today.

403. “Taxidermists in the US Industry Trends,” *IBISWorld*, March 26, 2021, <https://www.ibisworld.com/united-states/market-research-reports/taxidermists-industry/>.

404. Charles Bryant, “How Taxidermy Works,” *How Stuff Works*, accessed May 31, 2023, <https://adventure.howstuffworks.com/outdoor-activities/hunting/game-handling/taxidermy.htm>.

405. A taxidermist and his wife were among those infected when a new strain of SARS-CoV-2 apparently jumped from mink to humans on Michigan fur farms. There is also the possibility that the virus spilled over into other nearby animal species. It is not clear whether the individual obtained the virus from community spread through human populations or from interacting with dead wildlife, such as deer, who had been infected with the disease. However, this individual had no known connection to the fur farms where the outbreak first occurred. Emily Anthes, “The Michigan Mink Mystery: How Did an Interspecies Outbreak Unfold?” *The New York Times*, May 22, 2022, <https://www.nytimes.com/2022/05/22/health/coronavirus-mink-michigan-spillover.html>.

406. Dick Carpenter, Lisa Knepper, Kyle Sweetland, Jennifer McDonald, “Taxidermist,” in *License to Work*, 2nd edition, Institute for Justice, accessed May 31, 2023, <https://ij.org/report/license-work-2/tw-occupation-profiles/tw2-taxidermist/>.

407. Some states, including Montana and Texas, require taxidermists to keep a record of the animals they accept for mounting. However, not all taxidermists keep accurate or complete records. Some on occasion will falsify records in order to handle illegally poached animals. Stephen L. Eliason, “Trophy Poaching: A Routine Activities Perspective,” *Deviant Behavior* 33, No. 1, (2012): 72–87, DOI: 10.1080/01639625.2010.548289.

408. Bryant, Charles, “How Taxidermy Works,” *How Stuff Works*, accessed May 31, 2023, <https://adventure.howstuffworks.com/outdoor-activities/hunting/game-handling/taxidermy.htm>.

No federal law meaningfully regulates the captive hunting industry. States are left to regulate as much or as little as they choose.

No federal law meaningfully regulates the captive hunting industry.⁴⁰⁹ States are left to regulate as much or as little as they choose.⁴¹⁰ Many states, in particular those states with high numbers of captive hunting operations, allow them to operate with minimal oversight and impose few regulations. Where regulations do exist, even fewer are grounded in public health. Some states like Texas, which is home to a majority of the nation's captive hunting operations, incentivize the practice by providing subsidies

or tax benefits for the industry. In Texas, wildlife stocked for private hunting are classified by the state as "livestock," which shields them from regulations that might otherwise apply to wildlife.⁴¹¹ At the same time, they are not subject to public health regulations that govern traditional livestock production, despite the fact that some of these animals are processed for human consumption and may pose a greater risk of zoonotic disease than domestic livestock.⁴¹² This regulatory scheme allows captive hunting facilities to operate in a twilight zone as neither livestock nor wildlife, in some cases, escaping regulation altogether.^{413 414 415 416 417}

7. Commercial Upland Game Bird Production

There are over 40 million birds produced at over 3,000 commercial upland game bird facilities each year in the United States.^{418 419 420} In total, they comprise an industry valued at \$1.6 billion.⁴²¹

409. The Animal Welfare Act does not apply to game preserves, hunting preserves, and captive hunts. Some of the species on these ranches like the scimitar-horned oryx are threatened, endangered, or even extinct in the wild in the countries where they are or were native. But many species of exotic hoofstock on captive hunting ranches can be hunted legally because most are not in the list of Endangered Species, which focuses primarily on the protection of U.S. native species. For those species that are listed under the Endangered Species Act, the Fish and Wildlife Service allows ranches to hunt and kill certain animals that are federally designated as threatened or endangered species if the hunting preserves take certain steps. For example, one captive hunting preserve received an exception by donating 10 percent of its hunting proceeds to conservation programs. Manny Fernandez, "Blood and Beauty on a Texas Exotic-Game Ranch," *The New York Times*, Oct 19, 2017, <https://www.nytimes.com/2017/10/19/us/exotic-hunting-texas-ranch.html>.

410. The problem of classification is complicated—Is the activity "hunting" if the animals are captively bred and owned? On the other hand, is it "agriculture" if the animals are killed for entertainment?

411. Douglas Main, "A Behind-The-Scenes Look at Texas' Exotic Animal Ranches," *National Geographic*, July 7, 2020, <https://www.nationalgeographic.com/animals/article/inside-texas-exotic-animal-ranching-industry>.

412. Marcy Souza, "One Health: Zoonoses in the Exotic Animal Practice," *Vet Clin North Am Exot Anim Pract* 14, No. 3 (2011): 421-6, v. doi:10.1016/j.cvex.2011.05.007.

413. Main, Douglas. (July 7, 2020). A Behind-The-Scenes Look at Texas' Exotic Animal Ranches," *National Geographic*, July 7, 2020, <https://www.nationalgeographic.com/animals/article/inside-texas-exotic-animal-ranching-industry>.

414. Marcy Souza, "One Health: Zoonoses in the Exotic Animal Practice," *Vet Clin North Am Exot Anim Pract* 14, No. 3 (2011): 421-6, v. doi:10.1016/j.cvex.2011.05.007.

415. Wes Ferguson, "How Texas Hunting Went Exotic," *Texas Monthly*, February 2021, <https://www.texasmonthly.com/travel/how-texas-hunting-went-exotic/>.

416. Texas Admin Code 4.2. §36.1, §36.2, [https://texreg.sos.state.tx.us/public/readtac\\$ext.ViewTAC?tac_view=4&ti=4&pt=2&ch=36&rl=Y](https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=4&pt=2&ch=36&rl=Y).

417. "Exotic and Fur-bearing Species," *Texas Parks & Wildlife*, accessed May 7, 2023, <https://tpwd.texas.gov/education/hunter-education/online-course/wildlife-conservation/exotic-species>.

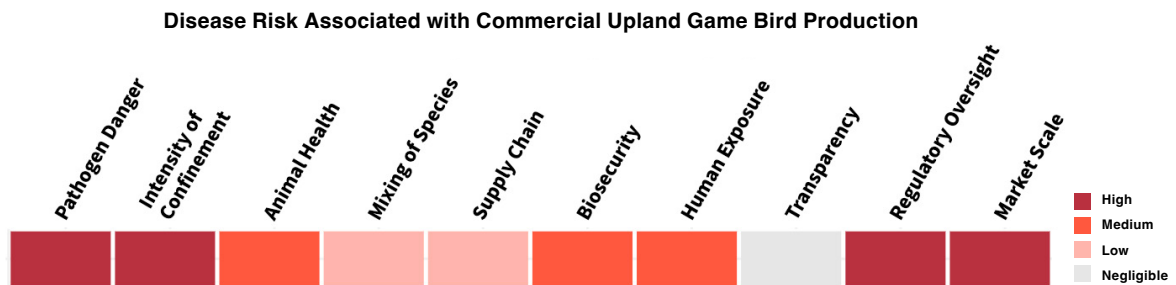
418. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., "Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting," *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

419. Kaitlyn St. Charles, "Interested into Getting into the Upland Gamebird Business?" *South Eastern Gamebird Breeders & Hunting Preserve Association*, last accessed April 21, 2023, <https://segamebirds.us/interested-into-getting-into-the-upland-gamebird-business/>.

420. Dale Lauer, "Report of the Committee on Transmissible Diseases of Poultry and Other Avian Species," *Proc. 121st Annual Meeting of the U.S. Animal Health Association*, Providence, Rhode Island (2015): <http://www.usaha.org/upload/Committee/TransDisPoultry/report-pad-2015.pdf>.

421. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., "Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting," *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

Ninety percent of birds produced in these facilities are sold for hunting on public or private land or for gun-dog training, where they are released, shot, and recovered by hunting dogs.⁴²²⁻⁴⁴³ Some are also sold to live bird markets where consumers select animals for slaughter onsite and consumption. Others are processed onsite at production facilities for sale as food to restaurants or supermarkets or kept as breeders in pens for the next year’s production cycle.⁴²⁴ In most of these supply chains, the animals are ultimately consumed by people.



Birds produced at upland commercial game facilities include a mix of both native and non-native species of wildlife, most commonly the Pharaoh Coturnix Quail, the Bobwhite Quail, the Chukar Partridge, the Ring-necked Pheasant, and the Northern Mallard Duck. Other more ornamental breeds such as the Hungarian Partridge are also becoming increasingly popular. Almost all commercial upland game bird production facilities are single-location operations and are either partially or fully vertically integrated where birds are bred, hatched, brooded, and grown to maturity at the same facility. The breeding and sales cycle is cyclical: chick hatching, in indoor cages similar to those used in conventional poultry operations, happens from mid-March to mid-August. The birds are then transferred outside in late summer to lower-density, large netted pens to grow and adapt to living outside. Birds are sold for live release from autumn to winter to match the optimal hunting months of different regions around the country. Though the largest facilities produce up to 300,000 game birds each year, the size of farms vary greatly with most holding under 1,000 birds at any one time.⁴²⁵



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422. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., “Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting,” *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

423. “Interested into Getting into the Upland Gamebird Business?” *South Eastern Gamebird Breeders & Hunting Preserve Association*, accessed December 9, 2022, <https://segamebirds.us/interested-into-getting-into-the-upland-gamebird-business/>.

424. In rare cases, producers also sell live animals into the exotic pet trade.

425. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., “Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting,” *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

Some portion of game birds raised at these commercial upland game bird facilities are sold to public entities, and specifically to states that wish to release them on public hunting grounds and sell permits to hunters to kill them. This practice is especially common in states like New Jersey and Connecticut, for example, which wish to create and maintain hunting markets for birds such as Ring-necked pheasants, who are neither native nor adapted species in the area, unable to survive naturally in the wild. Connecticut purchases over 20,000 pheasants a year from commercial breeding facilities for release, transporting the animals to state-owned hunting grounds and setting them free from cages just a few days before hunting season begins to minimize losses from predation.^{426 427} In Connecticut, an estimated 50%–60% of the birds which are released are killed by hunters each year.⁴²⁸ Some states, like Montana, instead elect to reimburse land owners for raising and releasing pheasants to increase the population for hunting.⁴²⁹

Other states have taken direct control of the process. The state of Wisconsin maintains its own state-run pheasant farms, which it uses to stock public lands at the start of hunting season.⁴³⁰ Pennsylvania too operates four game farms and distributes about 200,000 ring-necked pheasants annually.^{431 432}

Many of the 40 million commercial upland game birds produced through this industry are consumed without undergoing the health or safety checks required of other meat production. Hunters are free to eat the animals they kill, and states do not require health screening of animals bred and sold for this purpose. So while regulations require that a Bobwhite quail, sold by a game bird producer to a live animal food market, undergo health and safety checks before the animal can be eaten by customers, that same quail, if sold to a hunting preserve, could be released, shot, and eaten, and no regulations would apply.

Zoonotic risk is present at game bird farms wherever producers and animals interact. Producers collect eggs, sort and move chicks by hand, and handle birds regularly from the time they are embryos to the moment they are



Many of the 40 million commercial upland game birds produced through this industry are consumed without undergoing the health or safety checks required of other meat production.

426. The economics of this practice may be profitable for the state. For example, in Connecticut, it costs the state approximately \$14 per bird to buy, and licenses to hunt these birds are \$47. Bag limits in the state are two per day and 10 per season. Robert Miller, “From the Game Birds We Pay to Bring to CT to the Turkeys That Roam the State,” *CTInsider*, October 30, 2021, <https://www.ctinsider.com/columnist/article/Robert-Miller-From-the-game-birds-we-pay-to-16572899.php>.

427. Farmed-raised game birds have been shown to survive at about a tenth of the rate as caught wild birds that are released. Greg Breining, “Stocking Pheasants - Still in Demand, Still Futile,” *Pheasants Forever*, December 17, 2015, <https://www.pheasantsforever.org/BlogLanding/Blogs/Field-Notes/Stocking-Pheasants—Still-in-Demand,-Still-Futile.aspx?feed=articles>.

428. Most of the rest perish by winter time, becoming prey for predator species such as eagles, coyotes, bobcats, and hawks. Robert Miller, “From the Game Birds We Pay to Bring to CT to the Turkeys That Roam the State,” *CTInsider*, October 30, 2021, <https://www.ctinsider.com/columnist/article/Robert-Miller-From-the-game-birds-we-pay-to-16572899.php>.

429. “Upland Game Bird Release Program,” Montana Fish, *Wildlife & Parks*, accessed January 16, 2023, <https://fwp.mt.gov/conservation/landowner-programs/upland-game-bird-release-program>.

430. “State Game Farm,” *Wisconsin Department of Natural Resources*, accessed January 16, 2023, <https://dnr.wisconsin.gov/topic/lands/gamefarm.html>.

431. Pheasant Management Program,” Pennsylvania Game Commission, accessed January 16, 2023, <https://www.pgc.pa.gov/Wildlife/WildlifeSpecies/Ring-NeckedPheasant/Pages/PheasantManagement.aspx>.

432. New Jersey, which had long farmed its own pheasants, has recently moved to purchasing animals from private producers; however, state employees still sow seeds each spring to ensure that pheasants have adequate food and plant cover in the fall when they are released for hunting. “Pheasant and Quail Stocking,” *NJ Fish and Wildlife*, last updated January 12, 2023, <https://dep.nj.gov/njfw/hunting/stocking/>.

corralled and boxed for sale or release. Producers who slaughter and process birds onsite usually do so manually with a knife.⁴³³ Animals also die in the breeding process, and producers walk the pens frequently to collect and remove dead birds.⁴³⁴ When an animal becomes sick or injured, other birds will often attack it and sometimes consume it. Cannibalism has the potential to accelerate disease spread within captive game bird populations and remains an ongoing problem for producers.^{435 436}

Most often, production occurs in remote rural locations away from human settlement, which makes them more insulated but also requires that birds be transported long distances to customers of up to 1,000 miles increasing the opportunity for disease spread during transport. These rural locations allow significant crossover with native wildlife. Concerns regarding avian influenza and other wild-borne diseases are especially acute during the middle and later stages of production when the birds are kept outside, where they may come into contact with wild birds or their saliva or droppings, as well as small carnivores and rodents. The seasonal migrations of wild birds that occur each fall amplify this risk and expose captive flocks to any diseases these wild birds may carry, in particular where captive operations are situated in close proximity to water and wetlands that attract migratory waterfowl.^{437 438} Production facilities are susceptible to pathogens spread by wild birds but also have the potential to introduce disease to wild populations both during the production process, and later, when the birds are ultimately released.

There are, however, certain structural protections present in commercial upland game production operations that help mitigate the risk of disease spread. Because they are usually single sites and personnel, equipment, and vehicles are not shared between farms, there is less risk of disease transfer between two or more producers. Customers often source birds from a single production facility; however, there is typically no regular quarantine process for the hunting ranches and other operations that receive birds, which increases the risk of introducing disease.

Though the market for game birds is much smaller both in terms of overall volume and production scale than conventional poultry, it has proven to be a potential flashpoint for the spread of avian influenza—one that could serve as a conduit to introduce influenza strains circulating in wild birds to humans or to poultry.⁴³⁹ Between 1980 and 2017, there were 23 documented avian influenza outbreaks at commercial upland game bird facilities.⁴⁴⁰ Of these 23 outbreaks, more than 90% occurred during the

433. Ralph A. Ernst, Allen E. Woodard, Pran Vohra, and Carol Cardona, "Raising Game Birds," *University of California Division of Agriculture and Natural Resources*, Publication 8155, 2007, <https://anrcatalog.ucanr.edu/pdf/8155.pdf>.

434. Ralph A. Ernst, Allen E. Woodard, Pran Vohra, and Carol Cardona, "Raising Game Birds," *University of California Division of Agriculture and Natural Resources*, Publication 8155, 2007, <https://anrcatalog.ucanr.edu/pdf/8155.pdf>.

435. Frederic J. Hoerr, "Cannibalism in Poultry," *Merck Manual*, last modified October 2022, <https://www.merckvetmanual.com/poultry/miscellaneous-conditions-of-poultry/cannibalism-in-poultry>.

436. Many producers hand-fit blinders or hoods on the birds to reduce the impact of these behaviors, which are more common among birds held in close confinement. Ralph A. Ernst, Allen E. Woodard, Pran Vohra, and Carol Cardona, "Raising Game Birds," *University of California Division of Agriculture and Natural Resources*, Publication 8155, 2007, <https://anrcatalog.ucanr.edu/pdf/8155.pdf>.

437. Amos Ssematimba, Kaitlyn M. St. Charles, Peter J. Bonney, Sasidhar Malladi, et al. "Analysis of Geographic Location and Pathways for Influenza A Virus Infection of Commercial Upland Game Bird and Conventional Poultry Farms in the United States of America," *BMC Veterinary Research* 15, No. 47 (2019): <https://doi.org/10.1186/s12917-019-1876-y>.

438. Katharine E. Slota, Ashley E. Hill, Thomas J. Keefe, Richard A. Bowen, et al. "Biosecurity and Bird Movement Practices in Upland Game Bird Facilities in the United States," *Avian Diseases Digest* 6, No. 2 (2011): 180-186, <https://doi.org/10.1637/9722-950911-DIGEST.1>.

439. Katharine E. Slota, Ashley E. Hill, Thomas J. Keefe, Richard A. Bowen, et al. "Biosecurity and Bird Movement Practices in Upland Game Bird Facilities in the United States," *Avian Diseases Digest* 6, No. 2 (2011): 180-186, <https://doi.org/10.1637/9722-950911-DIGEST.1>.

440. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., "Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting," *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

Since H5N1 avian flu was first documented in North America in 2022, 16 commercial upland game farms from New York to Texas to Idaho reported outbreaks of the virus.

mature bird production stage in the summer and fall when the birds are outside and exposed to native wildlife.⁴⁴¹ Studies have documented other risk factors as well. For example, 70% of avian influenza outbreaks occurred at upland game bird production facilities that either had connections to live bird markets or raised ducks on site.^{442 443}

More recently, in 2022, avian influenza again spread to commercial upland game farms across the United States. Since H5N1 avian flu was first documented in North America in 2022, 16 commercial upland game farms from New York to Texas to Idaho have reported outbreaks of the virus.⁴⁴⁴ These outbreaks predictably follow the movements of wild birds. In October 2022, for example, as wild birds migrated south through the Central Flyway, highly pathogenic avian influenza infected a production facility in Nebraska that contained 159,000 game birds, all of whom were culled after the disease was found.⁴⁴⁵

In most states, game bird production is governed by the state's Department of Fish and Game, which establishes and enforces rules and regulations for the management of wildlife. In part because these agencies often both support and are supported by the hunting industry, regulation is typically loose and producer-friendly, especially with respect to native species and certain established exotic species.⁴⁴⁶ As a result, outside of a license, which can usually be obtained simply by showing proof of land ownership, payment of a fee, and agreement to self-report production volumes, commercial upland game producers remain largely unregulated in most states.⁴⁴⁷ Apart from this production license, producers are usually not subjected to additional oversight, nor are many of the birds they sell, in particular, those animals sold for hunting and later consumed. Birds produced on commercial upland game farms, while not otherwise regulated by the USDA, are nonetheless compensated by the Agency in the event of a disease outbreak, such as H5N1.^{448 449 450} At the same time, these animals are not subject to USDA

441. Amos Ssematimba, Kaitlyn M. St. Charles, Peter J. Bonney, Sasidhar Malladi, et al. "Analysis of Geographic Location and Pathways for Influenza A Virus Infection of Commercial Upland Game Bird and Conventional Poultry Farms in the United States of America," *BMC Veterinary Research* 15, No. 47 (2019): <https://doi.org/10.1186/s12917-019-1876-y>.

442. Amos Ssematimba, Kaitlyn M. St. Charles, Peter J. Bonney, Sasidhar Malladi, et al. "Analysis of Geographic Location and Pathways for Influenza A Virus Infection of Commercial Upland Game Bird and Conventional Poultry Farms in the United States of America," *BMC Veterinary Research* 15, No. 47 (2019): <https://doi.org/10.1186/s12917-019-1876-y>.

443. Kaitlyn St. Charles, Amos Ssematimba, Sasidhar Malladi et al., "Avian Influenza in the U.S. Commercial Upland Game Bird Industry: An Analysis of Selected Practices as Potential Exposure Pathways and Surveillance System Data Reporting," *Avian Diseases* 62, No. 3 (2018): 307-315, <https://doi.org/10.1637/11814-021518-Reg.1>.

444. Roy Graber, "Track 2022 Avian Influenza Outbreaks in North American Poultry," *WATTPoultry.com*, accessed December 9, 2022.

445. Roy Gaber, "159,500 Nebraska Commercial Gamebirds Lost to Avian Flu," *WATTPoultry.com*, October 5, 2022, <https://www.wattagnet.com/articles/45921-159-500-nebraska-commercial-gamebirds-lost-to-avian-flu>.

446. Ralph A. Ernst, Allen E. Woodard, Pran Vohra, "Raising Game Birds," *University of California Division of Agriculture and Natural Resources*, Publication 8155, 2007, <https://anrcatalog.ucanr.edu/pdf/8155.pdf>.

447. "Breeding of Domestic Game Birds," *New York State Legislation*, Environmental Conservation (ENV) Chapter 43-B, Article 11, Title 19 § 11-1901, September 22, 2014, <https://www.nysenate.gov/legislation/laws/ENV/11-1901>.

448. "Procedures for Indemnity and Compensation Claims in Cases of H5/H7 Low Pathogenicity Avian Influenza Infection in Poultry," *USDA*, VS Guidance 8603.2, May 24, 2021, https://www.aphis.usda.gov/animal_health/animal_diseases/avian/downloads/vsg-8603.2-procedures-claims-h5h7-lpai-poultry.pdf.

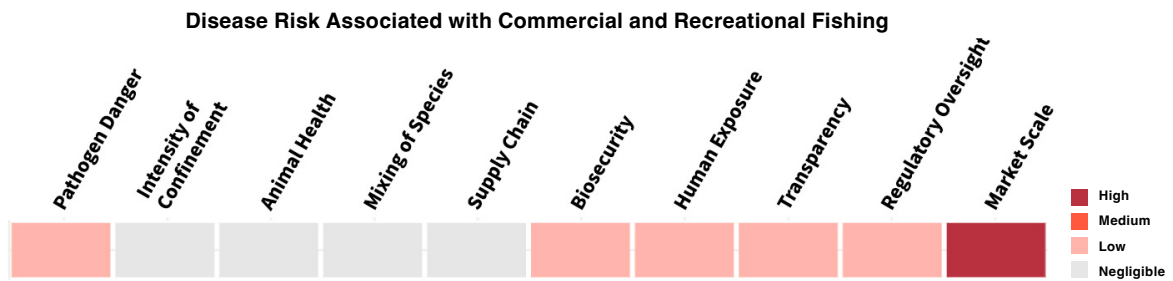
449. Game birds are not covered by the Poultry Products Inspection Act. The USDA does offer voluntary inspections on a pay-for-service basis. "What animals are inspected by the United States Department of Agriculture?" *AskUSDA*, March 24, 2023, <https://ask.usda.gov/s/article/What-animals-are-inspected-by-USDA>.

450. "Voluntary and Other Reimbursable Inspection Services—Revision 2," *USDA FSIS Directive* 12600.1 Section X, May 20, 2022, <https://www.fsis.usda.gov/policy/fsis-directives/12600.1#SectionX>.

regulations that govern most traditional poultry or livestock processing. The Poultry Product Inspections Act (PPIA) requires inspection for ducks and geese processed for slaughter for human consumption, but does not oversee other wild game species or wild game that are sold initially for non-consumption uses such as live release and hunting dog training, but that are ultimately consumed by people.⁴⁵¹

8. Commercial and Recreational Fishing

Both commercial and recreational fishing are large industries in the United States. Commercial fishing, which generally refers to the fishing and harvesting of wild fish and shellfish, is a \$9.7 billion disaggregated market with over 65,000 commercial fishing operators.⁴⁵² Although commercial fishing is quite a large industry in the United States, with over 9.7 billion pounds caught each year, the country imports over 80% of the fish consumed domestically.⁴⁵³ Recreational fishing, by contrast, is undertaken on an individual scale either as a leisure activity or for food. It is the nation’s second most popular outdoor activity after jogging, with nearly 1 in 7 Americans fishing at least once a year.⁴⁵⁴ In 2018, these recreational fishermen caught an estimated 956 million fish, with 64% released back into the water.⁴⁵⁵



Commercial and recreational fishing in the United States is regulated at both the federal and state level. At the federal level, the FDA is responsible for ensuring that the country’s fish supply is safe, sanitary, and properly labeled.⁴⁵⁶ The National Marine Fisheries Service (NMFS), which sits under the Department of Commerce, regulates commercial and recreational marine fisheries while FWS regulates freshwater fishing.^{457 458} FWS also oversees the National Fish Hatchery System, which is a network of 70 hatcheries that breed fish for release in lakes and rivers across the United States to buttress wild populations declining from habitat loss and overfishing. State agencies also carry out stocking

451. “What Animals are Inspected by the United States Department of Agriculture?” *US Department of Agriculture*, February 17, 2022, <https://ask.usda.gov/s/article/What-animals-are-inspected-by-USDA>.

452. John Madigan, “Fishing in the US,” *IBISWorld*, Industry Report 11411, February 2021.

453. “Global Wildlife Fisheries,” *National Oceanic and Atmospheric Administration*, accessed May 31, 2023, <https://www.fishwatch.gov/sustainable-seafood/the-global-picture>.

454. “New Report Highlights Recreational Fishing’s Broad Economic and Conservation Impact,” *American Sportfishing Association*, accessed May 28, 2022, <https://asafishing.org/reports/new-report-highlights-recreational-fishings-broad-economic-and-conservation-impact/>.

455. “2018 Report of the Fisheries of the United States,” *The International Game Fish Association*, September 4, 2018, <https://igfa.org/2020/04/23/fisheries-of-the-united-states-2018-report/>.

456. “Seafood,” *US Food and Drug Administration*, last updated April 17, 2023, <https://www.fda.gov/food/resources-you-food/seafood>.

457. “Understanding How Federal Fishing Regulations Are Made,” *National Oceanic and Atmospheric Administration*, accessed May 31, 2023, <https://www.fisheries.noaa.gov/insight/understanding-how-federal-fishing-regulations-are-made>.

458. The Magnuson–Stevens Fishery Conservation and Management Act of 1976 is the primary law governing fishing activities and it seeks to avoid overfishing to increase long-term economic and social benefits. Other relevant laws include the American Fisheries Act, the Aquaculture Act (which promotes and supports aquaculture) and the Lacey Act (which responds to illegal trade of fish). “Rules and Regulations,” *National Oceanic and Atmospheric Administration*, accessed May 31, 2023, <https://www.fisheries.noaa.gov/rules-and-regulations#fisheries>.

operations. In total, an estimated 3.6 billion hatchery-raised fish are released in the United States annually—almost ten for every American citizen.^{459 460} State and local governments generally regulate most fishing activities through permits, tags, or licenses.

Though aquatic species generally pose a lower risk of zoonoses than terrestrial animals, the handling, killing, gutting or processing of fish, as well as the use of smaller fish for bait, creates opportunities for disease transmission.⁴⁶¹ Most zoonoses carried by fish are bacterial pathogens including *Salmonella*, *Mycobacterium*, *Erysipelothrix*, *Campylobacter*, *Aeromonas*, *Vibrio*, *Edwardsiella*, *Escherichia*, *Klebsiella*, and *Streptococcus iniae*.⁴⁶² While disease transmission can occur through contact with live or dead fish, humans most commonly acquire fish-borne parasitic zoonoses through the consumption of infected raw, undercooked, or inadequately preserved fish.^{463 464 465} In the United States, from 1973 to 2006, approximately 180 outbreaks from seafood caused more than 4,000 illnesses, 160 hospitalizations, and 11 deaths.⁴⁶⁶



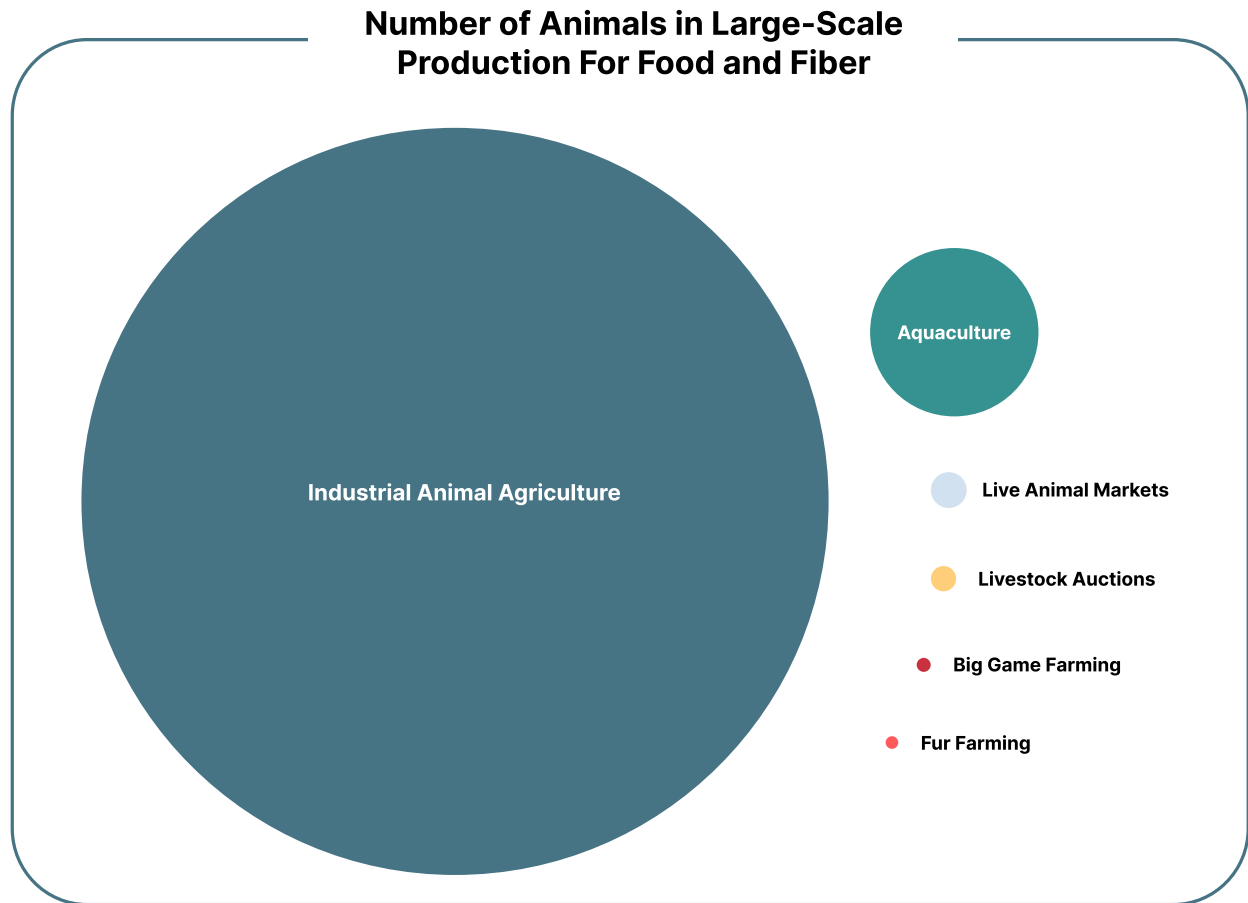
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459. Releasing hatchery-raised fish or eggs into wild waters can sometimes risk spreading disease to native wildlife or undermining ecosystem balance. For example, one study found that stocking efforts in the Pacific Northwest led to disease spread that increased amphibian embryo mortality by 15%. M. Anders Halverson, "Stocking Trends: A Quantitative Review of Governmental Fish Stocking in the United States, 1931 to 2004," *Fisheries Magazine* 33, No. 2 (February 2008): 69-75, <https://doi.org/10.1577/1548-8446-33.2.69>.
460. Saulius Šimčikas, "35-150 Billion Fish Are Raised in Captivity To Be Released Into the Wild Every Year," *Rethink Priorities*, April 2, 2019, <https://rethinkpriorities.org/publications/fish-raised-in-capacity-and-released-wild>.
461. Shane Boylan, "Zoonoses Associated with Fish," *Vet Clin North Am Exot Anim Pract.* 14, No. 3 (September 2011): 427-38, v. doi: 10.1016/j.cvex.2011.05.003. PMID: 21872780.
462. "Zoonoses Associated with Fish," *Institutional Animal Care and Use Committee*, Office of the Campus Veterinarian and the Office of Research Assurances, Washington State University, January 2021, <https://iacuc.wsu.edu/zoonoses-associated-with-fish/>.
463. Carlos A.M.Lima dos Santos and PeterHowgate, "Fishborne Zoonotic Parasites and Aquaculture: A Review," *Aquaculture* 318, No. 3-4 (August 2011): 253-261, <https://doi.org/10.1016/j.aquaculture.2011.05.046>.
464. Martha Iwamoto, Tracy Ayers, Barbara E. Mahon, and David L. Swerdlow. "Epidemiology of Seafood-Associated Infections in the United States," *Clin Microbiol Rev.* 23, No. 2 (April 2010): 399–411, doi: 10.1128/CMR.00059-09.
465. Joyce Evans, O. L. M. Haenen, Frank Berthe, "Overview of Zoonotic Infections from Fish and Shellfish," *Aquaculture America Conference*. P.315, Publication #289136, February 21, 2013, <https://www.ars.usda.gov/research/publications/publication/?seqNo115=289136>.
466. Tracy Ayers, Barbara E. Mahon, and David L. Swerdlow, "Epidemiology of Seafood-Associated Infections in the United States Martha Iwamoto," *Clin Microbiol Rev.* 23, No. 2 (April 2010): 399–411, doi: 10.1128/CMR.00059-09.



Large-Scale Production for Food and Fiber

This category includes animal production industries that raise millions of animals a year through formalized systems of production for food, fur, and other uses. Industrial animal agriculture, by far the biggest of all animal markets, produces over 10 billion animals a year in the United States.⁴⁶⁷ Also contained in this section are the related markets of livestock auctions and live animal food markets. Large-scale production of non-traditional livestock and of wildlife is also discussed, including big game farming, fur farming, and aquaculture.

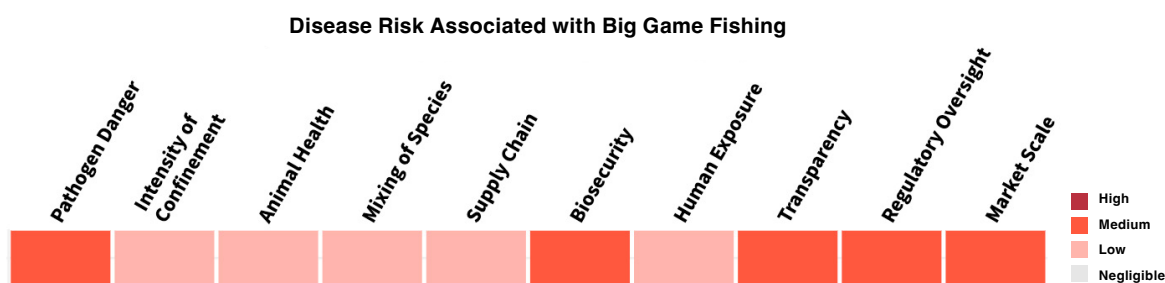


- Industrial Animal Agriculture, 10.1 billion animals**
- Aquaculture, 592 million animals**
- Live Animal Markets, 27 million animals**
- Livestock Auctions, 13 million animals**
- Big Game Farming, 4.4 million animals**
- Fur Farming, 3.2 million animals**

467. "Livestock Slaughter Annual Summary," *USDA Economics, Statistics, and Market Information System*, April 29, 2023, <https://usda.library.cornell.edu/concern/publications/r207tp32d>.

9. Big Game Farming

Big game farming in the United States typically takes place on large private ranches where captive wild animals are raised primarily for meat, as well as for other by-products, breeding stock, hunting, or aesthetic value. The United States has seen growing demand for ungulate meat, which is sometimes perceived as healthier or more natural. Species commonly farmed on these ranches include deer, elk, deer, bison, and yaks. The total direct economic impact of deer, elk and other cervid farming is estimated at over \$890 million.⁴⁶⁸ Major markets for bison, elk, and other big game meat producers often include wholesalers, restaurants, custom meat shops, and direct to consumers through mail-order or on-farm sales.⁴⁶⁹ Animals are selectively bred for consumptive use and kept in pens on feed and forage until they reach their desired market weights. Typically, they are provided some amount of veterinary care but disease remains a primary concern.⁴⁷⁰ The USDA reports that 61% of deaths among captive bison herds are the result of poor health or disease.⁴⁷¹



In part because big game species are not domesticated, transport presents additional stress for the animals and difficulty for producers.⁴⁷² Slaughter is often carried out at smaller facilities that may process fewer than a hundred animals a day. The Humane Methods of Slaughter Act does not apply to big game species.⁴⁷³ These animals are often killed by gunshot without stunning. The meat is often custom cut, vacuum packed, frozen, and shipped according to the buyer’s specifications.⁴⁷⁴ ⁴⁷⁵ Some of these farms also produce by-products such as hides or leather. One of the more sought-after by-products is elk antlers, which are sold for decoration, as dog toys, or for medicinal purposes.

468. David P. Anderson, Brian J. Frosch, Joe L. Outlaw, “Economic Impact of the United States Cervid Farming Industry,” *Agricultural & Food Policy Center Department of Agricultural Economics*, Texas A&M University, APFC Research Report 07-4, August 2007, <https://www.afpc.tamu.edu/research/publications/480/rr-2007-04.pdf>.

469. Others provide animals for captive hunting operations.

470. Matthew Butler, Andrew Teaschner, Warren Ballard, Brady McGee, “Commentary: Wildlife Ranching in North America—Arguments, Issues, and Perspectives,” *Wildlife Society Bulletin* 33, No. 1 (2005): 381–89, [https://doi.org/10.2193/0091-7648\(2005\)33\[381:CWRINA\]2.0.CO;2](https://doi.org/10.2193/0091-7648(2005)33[381:CWRINA]2.0.CO;2).

471. Jeff M. Martin and Chase Brooke, “Getting Started With Bison Ranching,” *South Dakota State University Extension*, last updated July 30, 2021, <https://extension.sdstate.edu/getting-started-bison-ranching>.

472. Robert McCorkell et al., “Transport versus on-farm slaughter of bison: physiological stress, animal welfare, and avoidable trim losses,” *The Canadian Veterinary Journal* 54, No. 8 (2013): 769-74, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3711167/>.

473. “Humane Methods of Slaughter Act: USDA Has Addressed Some Problems but Still Faces Enforcement Challenges,” *United States General Accounting Office*, GAO-04-247, January 2004, <https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-04-247/html/GAOREPORTS-GAO-04-247.htm>.

474. Jason Harper, “Bison Production,” *Agriculture Alternatives*, Penn State Extension, last modified October 10, 2005, <https://extension.psu.edu/bison-production>.

475. Catherine N. Cutter, “Proper Processing of Wild Game and Fish,” *Penn State Extension*, last modified December 15, 2020, <https://extension.psu.edu/proper-processing-of-wild-game-and-fish>.

In some cases, newly sprouted antlers are cut off of sedated immobilized elk, a process that can expose human handlers to contact with blood from velvet antlers.^{476 477 478}

Tuberculosis and brucellosis are two significant zoonoses found in farm-raised bison, deer, and elk. But, due in part to a 2015 federal eradication program in cattle and captive deer, these diseases are fairly uncommon in the United States.⁴⁷⁹ More recently (as noted above) farmed deer have been found to carry SARS-CoV-2. Researchers found that 30% of captive and wild deer tested in Iowa in 2020 carried SARS-CoV-2, with one herd having infection rates over 80%.⁴⁸⁰ USDA research in early 2020 showed that although deer did not show symptoms, they can transmit the disease.⁴⁸¹ At the time of this writing, deer appear to be spreading the disease back to humans.⁴⁸²

Big game farming also has the potential to spread disease to free-roaming wildlife or domestic livestock as well as to humans who interact with the animals along the supply chain. Enclosures are highly permeable, allowing for fence-line transmission of disease between captive animals and native wildlife.⁴⁸³ The dominant disease of concern in this respect is CWD, which has been reported in 29 states and is considered endemic in some, including Colorado, Wyoming, and Nebraska.⁴⁸⁴ In certain areas, roughly 10% of free-roaming deer carry the disease.⁴⁸⁵ However, in captive ranches, the incidence can be significantly higher. The CDC reports that, on some big game ranches, 79% of deer tested positive for CWD.⁴⁸⁶

Though CWD has not presently been shown to infect people, its management is a top priority in conservation medicine today, and there is some concern that CWD could infect humans, as studies have shown the disease is transmissible to other primates.^{487 488} As a result, there may be risk to people who consume meat from a CWD-infected animal, particularly because cooking does not destroy the prion that causes CWD.⁴⁸⁹

476. Pania Flint, "Velvet Antler Removal from Red Deer," *Massey University Thesis Presentation*, Doctor of Philosophy in Veterinary Medicine, 2012, <http://hdl.handle.net/10179/5911>.

477. Allen Rutberg, "Wildlife: Wanted Dead or Alive," *Serial—HSUS News 1989-93* 37, No. 1, Article 8, 1992, <https://www.wellbeingintlstudiesrepository.org/newshsus/vol37/iss1/8>.

478. There is also demand for antler blood for alternative medicine. Some believe drinking the blood or soaking in cervid blood will rejuvenate the skin, improve the cardiovascular system, and enhance sexual function. Alia Shoaib, "Putin Was Visited By a Cancer Surgeon Dozens of Times in 4 Years and Takes Rejuvenating Baths in Deer Antler Blood," *Business Insider*, April 2, 2022, <https://www.businessinsider.com/putin-health-cancer-fears-and-baths-in-deer-antler-blood-says-report-2022-4>.

479. "TB Brucellosis Summary Reports and Affected Herd Maps," *Animal and Plant Health Inspection Service*, USDA, last modified March 7, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/cattle-disease-information/tuberculosis-brucellosis-monthly-report/tb-bruc-reports>.

480. Kuchipudi, Suresh V., Surendran-Nair, Meera, Ruden, Rachel M. et al, "Multiple Spillovers and Onward Transmission of SARS-Cov-2 in Free-Living and Captive White-tailed Deer (*Odocoileus virginianus*)," *Proceedings of the National Academy of Sciences*, 119, No. 6 (January 25, 2022), <https://doi.org/10.1073/pnas.2121644119>.

481. Scott Elliott, "Farm Animals Tested for COVID Susceptibility Share," *Agriculture Research Service*, USDA, accessed May 31, 2023, https://tellus.ars.usda.gov/stories/articles/farm-animals-tested-for-covid-susceptibility/?utm_medium=email&utm_source=govdelivery.

482. Bradley Pickering, Oliver Lung, Finlay Maguire, et al., "Highly Divergent White-Tailed Deer SARS-CoV-2 with Potential Deer-to-Human Transmission," *bioRxiv*, May 24, 2022, <https://www.biorxiv.org/content/10.1101/2022.02.22.481551v3>.

483. Escape can also occur, particularly in the case of deer and other animals known to jump fences.

484. "Chronic Wasting Disease: Occurrence," *Centers for Disease Control and Prevention*, last updated April 17, 2023, <https://www.cdc.gov/prions/cwd/occurrence.html>.

485. "Chronic Wasting Disease: Occurrence," *Centers for Disease Control and Prevention*, last updated April 17, 2023, <https://www.cdc.gov/prions/cwd/occurrence.html>.

486. "Chronic Wasting Disease: Occurrence," *Centers for Disease Control and Prevention*, last updated April 17, 2023, <https://www.cdc.gov/prions/cwd/occurrence.html>.

487. "Chronic Wasting Disease In Domesticated Elk," *Colorado Department of Agriculture*, Animal Legal and Historical Center, accessed May 31, 2023, <https://www.animallaw.info/article/chronic-wasting-disease-domesticated-elk>.

488. In laboratory settings, CWD has been shown to infect species of non-human primates who were fed meat from CWD-infected animals. It may also have potential to change forms to become more transmissible. Osterholm, Michael et al. "Chronic Wasting Disease in Cervids: Implications for Prion Transmission To Humans and Other Animals," *mBio*, Vol. 10, Issue 4, <https://doi.org/10.1128/mBio.01091-19>.

489. "Health Advice for Harvesting, Preparing, and Eating Wild Game," *New York State*, last updated December 2022, https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/advice_on_eating_game.htm.

Except for the regulations regarding interstate transport of animals, there is no federal oversight of big game farming.⁴⁹⁰ While the USDA regulates slaughter of “amenable species”—defined as cattle, sheep, swine, goats, equines, and domesticated birds—under the Federal Meat Inspection Act and the Poultry Products Inspection Act, big game species fall outside this regulation. At the federal level, inspection of non-amenable species, such as deer, elk, bison, rabbits, quail, and others, is performed only on a voluntary basis through the USDA.^{491 492}

In order to sell the meat commercially for consumption, however, producers must process animals in a facility that is either USDA approved or licensed under a parallel state inspection system.^{493 494} The ratio of each varies by species, but with respect to bison, for example, roughly 85% of those commercially processed were slaughtered in federally approved facilities in 2016 (with the remaining amount slaughtered in state inspected facilities), as doing so allowed their meat to be sold interstate without navigating a patchwork state accreditation system.⁴⁹⁵ Still, some game farmers have found other ways to reduce regulation or circumvent inspection laws, such as allowing customers to butcher the animal themselves on site.⁴⁹⁶

Regulatory authority for big game farming is assigned differently in different states, such that a species may be considered wildlife in one state and domestic livestock in another. As a result, regulation of a particular species varies drastically from one state to the next, as does enforcement. Some states require big game farms to be permitted and inspected, while others do not. There is also no cohesive system of health certificates, import permits, and testing requirements for moving animals from one state to another.^{497 498} In recent years, however, due to the threat of CWD, there has been a proliferation of laws regulating interstate transport of deer and other cervids. Over half of states now participate in the USDA’s voluntary CWD herd certification program.⁴⁹⁹ The USDA has also authorized indemnification payments to compensate producers for culling of diseased herds.⁵⁰⁰

Except for the regulations regarding interstate transport of animals, there is no federal oversight of big game farming.

490. “Interstate Movement for Wild Caught Cervids,” *USDA Animal and Plant Health Inspection Service*, last updated June 2, 2022, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/cervid/cervid-interstate-movement>.

491. Unlike the slaughter of amenable species, voluntary inspections are paid for by the producer rather than taxpayers. FSIS inspectors perform ante-mortem visual inspections of herds, as well as post-mortem visual inspections of the animal and its entrails. However, many diseases cannot be diagnosed by looking at an animal’s physical appearance alone. 9 C.F.R. § 352.

492. Non-amenable species are exotic species which do not require inspection. Per 9 CFR 352.1(k) effective September 2021, “exotic animal” means any reindeer, elk, deer, antelope, water buffalo, bison, buffalo, or yak. “What are Non-Amenable Species?” *AskUSDA*, December 20, 2022, <https://ask.usda.gov/s/article/What-are-nonamenable-species>.

493. Many states do not offer their own state licensing system and instead rely on the federal system.

494. Elizabeth S. Byrd, Nicole J. Olynk Widmar, and John G. Lee, “Non-Amenable Meat Consumption, Sale, and Regulation: Bison, Beef, and Bambi, Oh My! All Meats Are Not Created Equal,” *Drake Journal of Agricultural Law*, May 30, 2016, <https://aglawjournal.wp.drake.edu/wp-content/uploads/sites/66/2018/10/ByrdFinalMacro.pdf>.

495. “Meat Inspection, Processing and Labeling Issues for Bison,” *National Bison Association*, September 2017, <https://bisoncentral.com/wp-content/uploads/2017/09/Small-Meat-Plant-Briefing-Paper.pdf>.

496. Jeff Beach, “Bison Rancher Looks to Cut Out the Middleman by Letting Customers Butcher Animal Themselves,” *AgWeek*, November 1, 2021, <https://www.agweek.com/business/bison-rancher-looks-to-cut-out-the-middleman-by-letting-customers-butcher-animal-themselves>.

497. “Management Authority over Farmed Cervids,” *Congressional Sportsmen’s Foundation*, accessed May 28, 2022, <https://congressionalsportsmen.org/policies/state/management-authority-over-captive-cervids>.

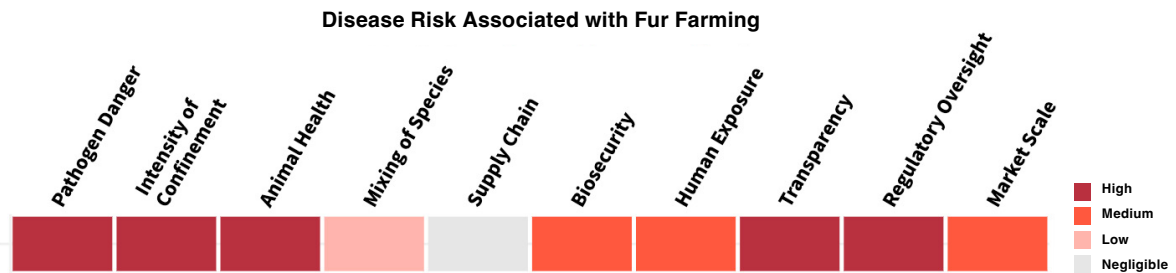
498. “Zoonoses Associated with Wild Ungulates,” *Washington State University*, Office of the Campus Veterinarian and the IACUC, January 2021, <https://iacuc.wsu.edu/zoonoses-associated-with-wild-ungulates/>.

499. “Cervids: CWD Voluntary Herd Certification Program,” *USDA Animal and Plant Health Inspection Service*, last modified January 11, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/cervid/cervids-cwd/cervids-voluntary-hcp>.

500. 9 C.F.R. § 55.

10. Fur Farming

Fur farming in the United States includes the practice of selecting, breeding, and raising fur-bearing mammals, such as mink, fox, rabbit, coyote, chinchilla, and raccoon, for their skins, known as “pelts.”^{501 502} Minks and foxes are two of the most common species on fur farms, with minks greatly outnumbering foxes. There are approximately 275 mink operations in 23 states which, in aggregate, produce about 3 million pelts annually, at a value of more than \$300 million.^{503 504} Some of these pelts are sold together in large lots at auctions to domestic buyers or internationally, through in-person or online sales.^{505 506}



Species on fur farms, especially minks and foxes, have been selectively bred over many generations for a range of desired characteristics, including color, size, quality of fur, and growth rate. The living conditions on farms can cause poor welfare and stress. Mink, who are usually housed in small wire cages averaging 1’x1’x3’, are themselves more than a foot long and have little room to move around.⁵⁰⁷ These cages are placed in deep rows, where the animals live side by side. Feces and urine fall through the wire mesh, preventing their fur from being dirtied, but causing further stress to the animals, who have a sensitive sense of smell and difficulty moving on an unstable wire floor. Runoff from manure leaks poses a threat to soil and water quality, which, in turn, can negatively impact nearby farmed and wild animals.⁵⁰⁸



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501. “Fur Farming,” *Four Paws in US*, accessed May 31, 2023, <https://www.four-paws.us/campaigns-topics/topics/fur/fur-farming>.

502. These farmed species are in addition to a range of species that are trapped from the wild, for example, bobcats, coyotes, beavers, lynx, sables, raccoons, foxes, mink, mountain lions, otters, and weasels.

503. “Mink Farming,” *Fur Commission USA*, accessed May 31, 2023, <https://www.furcommission.com/about-4-1>.

504. It should be noted that rising concerns in the United States over animal welfare in these fur farms have led to a decreased demand for fur products year-over-year since 2016. It is expected that the outbreak of COVID-19 in U.S. fur farms in 2020 will cause the industry decline to continue though prices may rise with reduced stock. “Mink,” *United States Department of Agriculture, Economics, Statistics and Market Information System*, last updated July 18, 2022, <https://usda.library.cornell.edu/concern/publications/2227mp65f>.

505. “Idaho Fish and Game online fur auction open, ends April 24, 2023,” *Big Country News*, April 14, 2023, https://www.bigcountrynewsconnection.com/idaho/idaho-fish-and-game-online-fur-auction-open-ends-april-24-2023/article_5a35f6e6-dafa-11ed-a131-7b6764146240.html.

506. Fur Harvesters Inc. website, accessed May 31, 2023, <https://www.furharvesters.com/>.

507. This is just enough space to stand up and turn around but not enough to move in any meaningful way. GJ Mason, J Cooper, C Clarebrough, “Frustrations of Fur-Farmed Mink,” *Nature* 410. No. 6824 (2001): pages 35-36.

508. “The Impacts of the Mink Industry on Freshwater Lakes in Nova Scotia: An Overview of Concerns,” *David Suzuki Foundation*, April 25, 2011, <https://www.furfreealliance.com/wp-content/uploads/2018/02/2011-Mink-Industry-and-Lakes-in-Nova-Scotia.pdf>.

As a result of their living conditions, fur-farmed animals can develop behavioral disorders and suffer compromised immune systems, making them more susceptible to disease.



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As a result of their living conditions, fur-farmed animals can develop behavioral disorders and suffer compromised immune systems, making them more susceptible to disease.^{509 510} Fur farms kill and process animals on site, using gas, blunt force trauma, or electrocution. After the pelts are removed by skinning, the carcasses are sometimes processed for oil or fertilizer. Disposal of carcasses can present secondary disease risks. In responding to outbreaks of COVID-19 among farm-raised mink, public health officials noted, “After we went onto these farms and saw what they considered to be composting, which really were just piled-up mink, we made the decision... to just have these buried at landfills,” in order to limit the likelihood of the virus spreading further.⁵¹¹

The threat of disease spread is high in fur farms where animals with low levels of genetic diversity are held in high densities and in poor conditions with no regulatory oversight. Biosecurity on fur farms is limited—often they are open-air and processors may or may not wear gloves or other PPE when interacting with live animals or carcasses.⁵¹² Disease risk is amplified too by the types of species involved. Most animals raised for fur are small carnivores, who present higher disease risk than other orders of mammals and may pose a greater risk of transferring zoonoses to humans.^{513 514}

Cognitively complex and communicative, mink are known to escape regularly, allowing pathogens to be transmitted to native wildlife, including other mink, and potentially allowing viruses to establish a permanent natural reservoir in these wild populations.⁵¹⁵

Documented disease outbreaks in U.S. fur farms have included influenza, toxoplasmosis, canine distemper, Aleutian mink disease parvovirus (ADV), and COVID-19. In total, 18 mink farms across four states experienced outbreaks of COVID-19.⁵¹⁶ The CDC waited several months after confirming that mink may have spread COVID-19 to farmworkers in Michigan before releasing this information publicly.⁵¹⁷

In total, 18 mink farms across four states experienced outbreaks of COVID-19.

509. RK Meagher, DLM Campbell DLM, JA Dallaire, M Diez-León, R, Palme R, and GJ Mason, “Sleeping Tight or Hiding in Fright? The Welfare Implications of Different Subtypes of Inactivity in Mink.” *Applied Animal Behaviour Science* 144, No. 3-4 (2013): 138-46.

510. In addition, fur-bearing animals are bred to maximize output which often causes deformity and obesity.

511. Kate Golden, “The Wild World of Mink and Coronavirus,” *Sierra Magazine*, January 7, 2021, <https://www.sierraclub.org/sierra/wild-world-mink-and-coronavirus>.

512. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

513. Other animals in the order Carnivora include palm civets, carriers of SARS-CoV-1.

514. Kevin J. Olival, Parvize R. Hosseini, et al, “Host and Viral Traits Predict Zoonotic Spillover From Mammals,” *Nature* 546, No. 29 (June 2017): 646-650, <https://doi.org/10.1038/nature22975>.

515. Though there has not been a dedicated effort to count escaped mink in the United States, in Ontario it was found that 64 percent of the mink trapped were either escapees or captive-wild hybrids (determined by size and color of animal trapped). Kate Golden, “The Wild World of Mink and Coronavirus,” *Sierra Magazine*, January 7, 2021, <https://www.sierraclub.org/sierra/wild-world-mink-and-coronavirus>.

516. Jim Keen, “Mink Farming and SARS-CoV-2,” *Center for a Humane Economy*, January 2022, <https://centerforahumaneconomy.org/wp-content/uploads/2022/03/Mink-Farming-SARS-CoV-2-by-Jim-Keen-DVM-PhD.pdf>.

517. Dina Fine Maron, “Government Documents Reveal CDC Delayed Disclosing Likely COVID-19 Animal Spillover Event,” *National Geographic*, April 5, 2022, <https://www.nationalgeographic.com/animals/article/government-emails-reveal-cdc-secrecy-around-likely-animal-spillover-of-covid>.

This cycle of a virus spilling over from humans to animals and then back again risks creating new and more dangerous forms of existing human pathogens.

Countries like Denmark moved quickly to contain COVID-19 outbreaks on fur farms, culling 17 million mink to prevent the virus's spread, while the United States chose not to require cullings.⁵¹⁸ Of the 250 escaped minks that the USDA and CDC captured around one Utah farm, one-third were infected with SARS-CoV-2.^{519 520} Some of these minks are thought to have contracted COVID-19 after being exposed by infected workers, a process called reverse zoonosis, whereby disease passes from humans to other animals.⁵²¹ Mink are also one of the only known species to have

passed COVID-19 back to humans. This cycle of a virus spilling over from humans to animals and then back again risks creating new and more dangerous forms of existing human pathogens.

There is no federal regulation that governs the treatment, health, housing conditions, or slaughter of animals raised on fur farms.⁵²³ The AWA exempts domesticated fur-bearing animals as "farm animals," leaving fur farms outside of the purview and inspection of the USDA APHIS.⁵²⁴ Fur farms are not licensed by federal wildlife authorities, either. As a result, fur farms fall into a regulatory void. In many states, neither agricultural nor wildlife agencies regulate fur farms at all. A handful require operators to obtain a license, but in others, public health authorities may not know how many fur farms exist in a state or where they are located, leading to delayed response times and significant exposure when a disease outbreak occurs. When COVID-19 spread through mink farms in Wisconsin, the Wisconsin State Veterinarian had to ask an industry trade group, the Fur Commission USA, how to reach the farmers and how many there were.^{525 526}

Because of carve-outs in federal legislation and minimal state regulation, fur farms are largely self-regulated. Fur Commission USA, the largest industry trade association, offers voluntary guidelines for producers seeking its certification label.



Fur farms fall between the oversight of agricultural and wildlife agencies

518. "Denmark to Cull Up to 17 Million Mink Amid Coronavirus Fears," *BBC News*, November 5, 2020, <https://www.bbc.com/news/world-europe-54818615>.

519. Sonia Shah, "Animals That Infect Humans Are Scary. It's Worse When We Infect Them Back," *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

520. Prior to this, SARS-CoV-2 infection has not been documented in any other intensively farmed species, suggesting that mustelids may exhibit a higher susceptibility to the virus. Mustelids are fur-bearing carnivores that inhabit terrestrial and aquatic regions throughout the world, except Australia, Antarctica, and most oceanic islands. Examples include badgers, otters, ferrets and martens. Costanza Mane, Rania Gollakner, and Ilaria Capua, "Could Mustelids Spur COVID-19 Into a Panzootic?" *Veterinaria italiana* 56, (2020): doi: 10.12834/Vett.2375.13627.1.

521. Kirstin Spence, "What is Reverse Zoonosis," *News Medical Life Sciences*, last updated November 11, 2021, <https://www.news-medical.net/health/What-is-Reverse-Zoonosis.aspx>.

522. Sonia Shah, "Animals That Infect Humans Are Scary. It's Worse When We Infect Them Back," *The New York Times*, January 19, 2022, <https://www.nytimes.com/2020/11/08/science/Covid-virus-transmission-mink.html>.

523. Regulations instead focus on labeling practices and other forms of consumer protection.

524. They are also exempt from the Human Methods of Slaughter Act as non-amenable species. Other federal laws that may be tangentially implicated include the ESA, the Lacey Act, and the Humane Methods of Slaughter Act ("HMSA"). However, most species that are bred for fur farming are not endangered, and both the HMSA and the AWA exempt fur-farmed animals, leaving them effectively unregulated.

525. Kate Golden, "The Wild World of Mink and Coronavirus," *Sierra Magazine*, January 7, 2021, <https://www.sierraclub.org/sierra/wild-world-mink-and-coronavirus>.

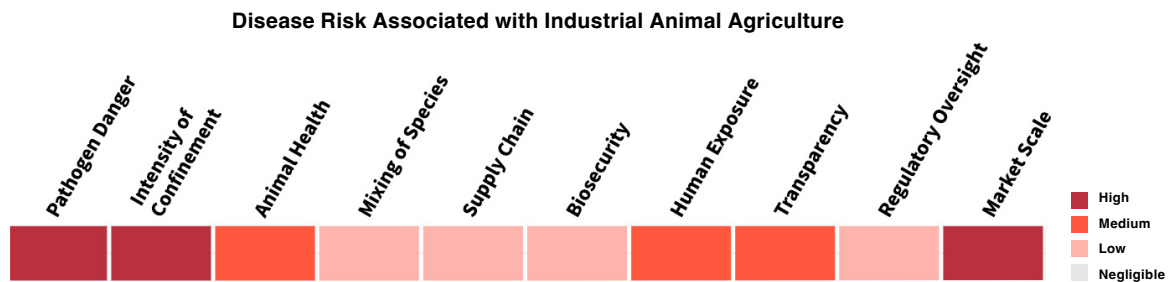
526. In a letter published in the *Lancet*, virologists studying the zoonotic threat posed by fur farms and their risk of mink farming creating new natural reservoirs of disease by spreading viruses to native wildlife noted, "(T)here is currently no global overview of the location of such farms, and no mandatory surveillance programme. In view of our observations, that is urgently needed." Marion Koopmans, "SARS-CoV-2 and the Human-Animal Interface: Outbreaks on Mink Farms," *The Lancet Infectious Diseases* 21, No. 1 (January 2020): 18-19, [https://doi.org/10.1016/S1473-3099\(20\)30912-9](https://doi.org/10.1016/S1473-3099(20)30912-9).

However, its recommendations carry no force of law.⁵²⁷ As a result, although the fur farming industry presents a significant zoonotic disease threat, combining high-risk species and high-risk practices, it remains almost entirely unregulated.^{528 529} Finally, because fur-bearing animals are not considered livestock, producers are not eligible for indemnity payments from the USDA if their animals are culled because of a disease outbreak.⁵³⁰ As a result, producers have little incentive to report disease outbreaks for fear of financial losses.

11. Industrial Animal Agriculture

Livestock carry many pathogens that are transmissible to humans. Research suggests that eight of the 10 mammalian species who share the highest number of viruses with humans are domestic species including pigs, cattle, sheep, and goats.⁵³¹ The largest concentrations of these animals are found in food production.

Eight of the 10 mammalian species who share the highest number of viruses with humans are domestic species including pigs, cattle, sheep, and goats.



In the United States, chickens, cows, and pigs are the dominant forms of livestock. Small independent farms have all but given way to large, consolidated production facilities. Ninety-eight percent of livestock in the United States live on large-scale facilities known as CAFOs (“concentrated animal feeding operations”), colloquially called “factory farms.”^{532 533} CAFOs are officially defined by the USDA as operations that house more than 2,500 swine, 1,000 head of beef cattle (raised for meat), 700 dairy cows (raised for milk), 125,000 broiler chickens (raised for meat), or 82,000 laying hens or pullets (raised for eggs).^{534 535}

527. John O’Connell, “Mink Industry Thrives Despite Threats,” *The Astorian*, December 7, 2018, https://www.dailystar.com/news/local/mink-industry-thrives-despite-threats/article_b23d274e-182d-5427-af1c-5230135a5df5.html.

528. A U.S. House bill was introduced in July 2021 to ban the farming of mink in the United States in an effort to control disease spread; however, the bill was not enacted. “MINKS are Superspreaders Act,” H.R. 4310, 117th Congress, 2021-2022, <https://www.congress.gov/bills/117/congress-house-bill/4310/text?r=1&s=1>.

529. Bas B. Oude Munnink, Reina S. Sikkema David F. Nieuwenhuijse, et al, “Transmission of SARS-CoV-2 on Mink Farms Between Humans and Mink and Back to Humans,” *Science* 371, No. 6525 (November 10, 2020): 172-177, doi: 10.1126/science.abe5901.

530. Casey Barton Behravesh (Captain, U.S. Public Health Service; Director, One Health Office), email message to Janet Blair and Leah Gilbert, October 8, 2020, https://www.documentcloud.org/documents/21562819-cdc_foia_pg_1893-1901suicide-prevention?responsive=1&title=1.

531. Christine Johnson, Peta Hitchens, Pranav Pandit, Julie Rushmore, et al, “Global Shifts in Mammalian Population Trends Reveal Key Predictors of Virus Spillover Risk,” *Proc R Soc B Biol Sci* 287, No. 1924 (April 8, 2020), <https://doi.org/10.1098/rspb.2019.2736>.

532. CAFOs are regulated under the National Pollutant Discharge Elimination System (NPDES) of the EPA. “Animal Feeding Operations (AFOs),” *United States Environmental Protection Agency*, accessed May 31, 2023, <https://www.epa.gov/npdes/animal-feeding-operations-afos>.

533. Calculations are based on USDA Census of Agriculture Data. See: Jacy Reese Anthis, “U.S. Factory Farming Estimates,” *Sentience Institute*, April 11, 2019, <https://www.sentienceinstitute.org/us-factory-farming-estimates>.

534. “Animal Feeding Operations,” USDA Natural Resources Conservation Service, accessed May 31, 2023, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afo/>.

535. To avoid increased regulation, some operations deliberately stay just under these number thresholds.



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LIVESTOCK SUBSIDIES

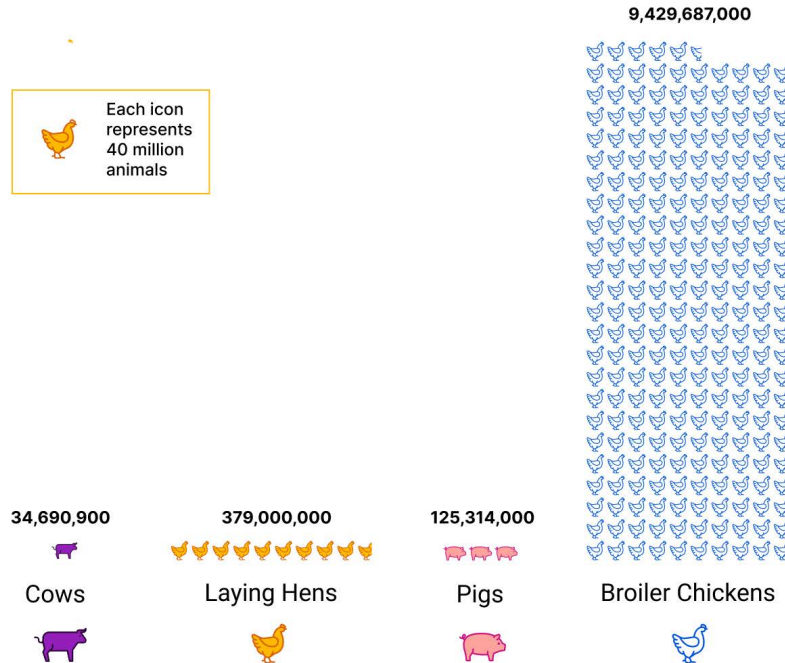
CAFOs are heavily subsidized by taxpayer funding.⁵³⁶ Each year the United States spends an estimated \$38 billion to subsidize meat and dairy producers.⁵³⁷ In addition, the USDA oversees \$557 million in “checkoff funding” spent on advertising campaigns to promote the consumption of meat and dairy, compared to just \$51 million spent to promote fruits and vegetables.⁵³⁸ As subsidies have increased, consumer prices have fallen to artificial lows. For example, when adjusting to account for inflation, a pound of chicken cost \$6.89 in 1950 but less than \$2.00/lb in 2022.⁵³⁹ Some studies estimate the true cost passed on to taxpayers of each fast food burger, which retails for \$4.49 on average, is between \$2.90–\$7.00.^{540 541 542}

Still, major meat conglomerates are the primary beneficiaries of these subsidies. The current industry model implemented by the major processors—including Tyson, JBS, and Cargill—puts the majority of the risk on contract farmers, while taking steps to insulate themselves from risk in the event of a disease outbreak or poor yield.⁵⁴³

536. Farm subsidies date back to the 1920s when price disparities and price volatility after World War I led to extreme hardships in the agricultural economy. Subsidies have continued and grown ever since despite stabilization in pricing.
537. Indira Joshi, Seetharam Param, Milind Gadre, et al, “Saving the Planet: The Market for Sustainable Meat Alternatives,” *University Of California Berkeley, Sutardja Center for Entrepreneurship & Technology*, November 10, 2015, <https://scet.berkeley.edu/wp-content/uploads/CopyofFINALSavingThePlanetSustainableMeatAlternatives.pdf>.
538. “The Meatonomics Index,” *Meatonomics*, August 22, 2013, <https://meatonomics.com/2013/08/22/meatonomics-index/>.
539. “Average Retail Food and Energy Prices, U.S. and Midwest Region,” *U.S. Bureau of Labor Statistics Mid-Atlantic Information Office*, accessed May 31, 2023, https://www.bls.gov/regions/mid-atlantic/data/averageretailfoodandenergyprices_usandmidwest_table.htm.
540. Note that these estimates account for subsidies as well as other externalities. Mark Bittman, “The True Cost of a Burger,” *The New York Times*, July 15, 2014, <https://www.nytimes.com/2014/07/16/opinion/the-true-cost-of-a-burger.html>.
541. Indira Joshi, Seetharam Param, Irene, Milind Gadre, “Saving the Planet: The Market for Sustainable Meat Alternatives,” *Sutardja Center for Entrepreneurship & Technology Technical Report*, November 10, 2015, <https://scet.berkeley.edu/wp-content/uploads/CopyofFINALSavingThePlanetSustainableMeatAlternatives.pdf>.
542. David Robinson Simon, *Meatonomics* (Berkeley, California: Conari Press, 2013).
543. In the contract farming model, the chicken farmer will bear responsibility for the capital cost of the facility, yet the poultry themselves are provided and owned by the corporate producers who also oversee transport of the animals. The farmer is paid by quality of output. If a flock dies or does not reach premium weights, the farmer does not get compensated at the rate expected. With a weak flock, a farmer often struggles to pay off the mortgage on the facility. Under such a system, in the event of a disease outbreak, producers tend to blame the contract farmers/growers, who assume virtually all of the risk under this model.

America’s immense demand for animal-based food products, including meat, eggs, and dairy, along with billions in government subsidies, fuel the country’s vast animal production industry.⁵⁴⁴ In aggregate, CAFOs in the United States produce over 9.4 billion chickens, 200 million turkeys, 125 million pigs, 380 million laying hens, and over 34 million beef and milking cows annually.^{545 546 547 548 549} Industrial meat markets are vertically integrated and highly consolidated. The four largest producers control 82% of the U.S. beef market, 66% of the U.S. pork market, and 54% of chicken processing.^{550 551}

Number of Animals Slaughtered Annually at USDA-Licensed Facilities



The Environmental Protection Agency (EPA) estimates that there are over 19,000 CAFOs in the United States, with more than 430,000 similar but smaller operations known as AFOs (“animal feeding operations”).^{552 553 554} Industrial animal agriculture facilities are spread across the country, but found most

544. In 2020, the U.S. government gave out over \$46 billion in agricultural subsidies representing nearly 40 percent of net farm income. Farm subsidies date back to the 1920s when price disparities and price volatility after World War I led to extreme hardships in the agriculture economy. Subsidies have continued and grown since, despite stabilization in pricing due in part to massive consolidation in the industry. Associated Press, “U.S. Government Checks Constituted 40% of Farmers’ Income in 2020: USDA,” *MarketWatch*, December 31, 2020, <https://www.marketwatch.com/story/u-s-government-checks-constituted-40-of-farmers-income-in-2020-usda-0160944429>.

545. “Broiler Chicken Industry Key Facts 2021,” *National Chicken Council*, accessed May 31, 2023, <https://www.nationalchickencouncil.org/about-the-industry/statistics/broiler-chicken-industry-key-facts/>.

546. Chris McGreal, “How America’s Food Giants Swallowed the Family Farms,” *The Guardian*, March 9, 2019, <https://www.theguardian.com/environment/2019/mar/09/american-food-giants-swallow-the-family-farms-iowa>.

547. M. Shahbandeh, “Total Number of Laying Hens in the U.S. 2000-2021,” *Statista*, March 25, 2022, <https://www.statista.com/statistics/195823/total-number-of-laying-hens-in-the-us-since-2000/>.

548. M. Shahbandeh, “Number of Beef and Milk Cows in the United States from 2001 to 2019,” *Statista*, January 28, 2022, <https://www.statista.com/statistics/194302/number-of-beef-and-milk-cows-in-the-us/>.

549. “Livestock Slaughter,” *USDA National Agricultural Statistics Service*, May 19, 2022, https://www.nass.usda.gov/Publications/Todays_Reports/reports/lstk0522.pdf.

550. Shefali Sharma, “Companies: Dominating the Market from Farm to Display Case,” *Institute of Agriculture and Trade Policy*, September 8, 2021, <https://www.iatp.org/companies-dominating-market-farm-display-case>.

551. Brian Deese, Sameera Fazili, and Bharat Ramamurti, “Addressing Concentration in the Meat-Processing Industry to Lower Food Prices for American Families,” *The White House Briefing Room*, September 8, 2021, <https://www.whitehouse.gov/briefing-room/blog/2021/09/08/addressing-concentration-in-the-meat-processing-industry-to-lower-food-prices-for-american-families/>.

552. “Animal Feeding Operations,” *USDA NRCS*, accessed May 31, 2023, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afao/>.

553. CAFOs are regulated under the National Pollutant Discharge Elimination System (NPDES) of the EPA. “Animal Feeding Operations,” *EPA National Pollutant Discharge Elimination System*, last updated February 16, 2023, <https://www.epa.gov/npdes/animal-feeding-operations-afos>.

554. Christopher Walljasper, “Large Animal Feeding Operations on the Rise,” *MidWest Center for Investigative Reporting*, June 7, 2018, <https://investigatmidwest.org/2018/06/07/large-animal-feeding-operations-on-the-rise/>.

often in rural and low income areas, leading to inequitable health and environmental burdens for these communities.⁵⁵⁵ Intensive animal production poses large-scale threats to public health, despite some of the strictest biosecurity measures of any animal industry.⁵⁵⁶ Access to these facilities is tightly controlled. However, sealing them off and keeping animals entirely indoors can reduce the frequency but increase the magnitude of disease outbreaks.

In CAFOs, hundreds of thousands or millions of animals can be held together in intense confinement with limited air flow, making these facilities ripe for pathogen transmission among animals as well as between animals and workers. Systems of production vary by use and by species. Pigs and chickens are kept entirely indoors in long enclosed warehouses. Beef cows begin their life on pasture before being transported to feedlots where they are housed outside in large numbers until they reach their slaughter weight of 1,100 lbs.⁵⁵⁷ Dairy cows are kept under a different system and held predominantly indoors, where they go through cycles of artificial insemination, pregnancy, calf removal, and milking.⁵⁵⁸

Intensive animal production poses large-scale threats to public health, despite some of the strictest biosecurity measures of any animal industry.

FOIE GRAS

While in the United States, foie gras production usually happens on a smaller scale than many other forms of intensive farming, operations may house tens of thousands of animals. Hudson Valley Foie Gras, one of the largest producers, produces 7,000 ducks per week, with each employee responsible for force-feeding roughly 500 birds per day.⁵⁵⁹ Foie gras is typically produced through the process of force-feeding male ducks or geese a high-fat diet to enlarge their liver (up to ten times the normal size) and increase the fat content of their liver. During the force-feeding process, known as gavage, producers hold open the animal's mouth, and hold their head still while they insert a metal or plastic tubedown the animal's throat through which they deliver a large amount of corn. Mortality rates are high, as many animals die from ruptured organs during the gavage process. This process takes place twice or three times a day for a period of two to three weeks before the animals are slaughtered.

Foie gras production allows for significant disease exposure given the intensity of the physical contact between the animals and producers during the force-feeding and the likelihood that producers may come into contact with saliva or other fluids. Because ducks are potential reservoirs for avian influenza, the close interaction is particularly concerning; elsewhere, in France, foie gras production facilities have documented outbreaks of avian influenza.⁵⁶⁰

The American livestock production system strives to deliver meat that is both uniform and inexpensive. Industrial producers seek to maximize efficiency in every aspect of production, such that animals cycle through facilities as quickly as possible and are slaughtered as soon as they reach

555. Elizabeth Overcash, "Detailed Discussion of Concentrated Animal Feeding Operations: Concerns and Current Legislation Affecting Animal Welfare," *Michigan State University College of Law, Animal Legal and Historical Center*, 2011, <https://www.animallaw.info/article/detailed-discussion-concentrated-animal-feeding-operations>.

556. This is more true of some species than others and varies by stage of production. For example, feedlots present far greater opportunities for contact with wildlife than an indoor poultry facility.

557. The cow-calf industry focuses on earlier-maturing cattle, while the feeding industry's goal is to produce cattle at ever-increasing weights. The vast majority—97%—of cattle are fattened, or "finished," with corn-based diets at feedlots that are concentrated in the Great Plains but are also located in parts of the Corn Belt, Southwest, and Pacific Northwest. Troy Marshall, "Cow-Calf vs. Feedlot," *Beef*, August 26, 2011, <https://www.beefmagazine.com/business/troy-marshall/0826-cowcalf-feedlot>.

558. There are over 50,000 dairy farms in the United States, with California producing the most milk in the United States in 2019 followed by Wisconsin and Idaho. Rob Cook, "Ranking of States That Produce The Most Milk," *Beef2Live*, July 22, 2022, <https://beef2live.com/story-milk-production-ranking-state-0-111564>.

559. "Hudson Valley Foie Gras Farm on Edge After Proposed NYC Ban," *Spectrum News 1*, September 5, 2019, <https://spectrumlocalnews.com/nys/hudson-valley/news/2019/09/05/hudson-valley-foie-gras-farm-on-edge-after-proposed-nyc-ban>.

560. François-Xavier Briand, Eric Niqueux, Audrey Schmitz, Claire Martenot, et al., "Highly Pathogenic Avian Influenza A(H5N8) Virus Spread by Short- and Long-Range Transmission, France, 2016–17," *Emerging Infectious Diseases* 27, No. 2 (February 2021): 508–516, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7853534/>.

sufficient size. This cycle takes about two months for chickens, six months for pigs, and 20 months for cattle.⁵⁶¹

This pursuit of efficiency often means raising as many animals as possible in as little space as possible. Poultry barns often stretch 600 feet in length and house animals at high densities.⁵⁶² A single broiler chicken facility may hold more than five million birds, roughly the same human population as Colorado and more than most U.S. states. At the same time, an egg-laying hen in a so-called battery cage, for example, is allocated only a nine-by-nine inch square of floorspace, an area smaller than a sheet of paper.⁵⁶³ Rapid breeding and growth necessitate the use of large amounts of resources. A single sow may give birth to 36 piglets a year, each of which is later fed six to 10 pounds of corn and soybeans per day.⁵⁶⁴ CAFOs increase their efficiency by purpose-breeding animals and eliminating those which are not desired or productive, macerating 200-300 million male chicks born into the egg industry each year.⁵⁶⁵ CAFOs also produce roughly 500 million tons of sewage a year, which is often held in open tubs known as “manure lagoons” or spread, untreated, on crop land.⁵⁶⁶ A single hog facility can produce more sewage per year than the city of Philadelphia.⁵⁶⁷



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As the size and stocking density of animal production facilities increase, so too does the likelihood of a potential outbreak.^{568 569} The vast scale of these operations and density of animals make them extremely conducive to disease transmission between animals, as does the lack of airflow.

561. “Factory Farming And Animal Life Cycles,” *FootPrint.com*, last updated May 8, 2023, <https://foodprint.org/issues/factory-farming-and-animal-life-cycles/>.
562. “Agricultural Resource Management Survey Broiler Highlights,” *USDA National Agriculture Statistics Service*, accessed May 8, 2023, https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Ag_Resource_Management/ARMS_Broiler_Factsheet/Poultry%20Results%20-%20Fact%20Sheet.pdf.
563. “Animal Husbandry Guidelines for U.S. Egg-Laying Flocks,” *United Egg Producers*, accessed May 31, 2023, https://uepcertified.com/wp-content/uploads/2020/02/Caged-UEP-Guidelines_17.pdf.
564. Laia Blavi, David Solà-Oriol, Pol Llonch, Sergi López-Vergé, “Management and Feeding Strategies in Early Life to Increase Piglet Performance and Welfare around Weaning: A Review,” *Animals (Base)* 11, No. 2 (2021): 302, doi: 10.3390/ani11020302.
565. Using or disposing of this many animals safely can create environmental and public health challenges. Many are fed into other industries such as pet food production. Michael Brice-Saddler, “France Says It’s Poultry Industry Will Stop Shredding Male Chicks Alive by 2022,” *The Washington Post*, Jan. 29, 2020; Meaghan Wray, “Germany, France Push to End Male Chick ‘Shredding’ in European Union,” *Global News*, Jan. 16, 2020.
566. Michele M. Merkel, “EPA and State Failures to Regulate CAFOs Under Federal Environmental Laws,” *Environmental Integrity Project*, accessed May 31, 2023, https://environmentalintegrity.org/pdf/publications/EPA_State_Failures_Regulate_CAFQ.pdf.
567. Carrie Hribar, “Understanding Concentrated Animal Feeding Operations and Their Impact on Communities,” *National Association of Local Boards of Health*, 2010, https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf.
568. Justin Bernstein and Jan Dutkiewicz, “A Public Health Ethics Case for Mitigating Zoonotic Disease Risk in Food Production,” *Food Ethics* 6, No. 9 (2021): <https://doi.org/10.1007/s41055-021-00089-6>.
569. Bryony Jones, Delia Grace, Richard Kock et al., “Zoonosis Emergence Linked to Agricultural Intensification and Environmental Change,” *Proceedings of the National Academy of Sciences* 110, No. 21 (May 13, 2013): 8399–8404, <https://doi.org/10.1073/pnas.1208059110>.

Concentrating animals in numbers and in closed environments seldom seen in nature can also give pathogens opportunities to rapidly evolve and generate new forms.

At a small-scale farm, using less intensive forms of production, disease may impact some animals but not all of them, while in a CAFO, pathogens may infect virtually every animal.⁵⁷⁰ Concentrating animals in numbers and in closed environments seldom seen in nature can also give pathogens opportunities to rapidly evolve and generate new forms.⁵⁷¹

Most animals held in CAFOs lack the genetic diversity that can act as a natural buffer for disease.⁵⁷² As the USDA's Agricultural Research Service explained, "The U.S. currently

has the largest, most genetically homogeneous and, thus potentially, the most disease-susceptible population of food animals in the history of mankind... The emergence of a new disease or a slight shift in the epidemiology of an existing disease could lead to immediate and disastrous results..."⁵⁷³ Like storing tanks of gasoline next to a fire, holding such vast numbers of genetically similar animals can also amplify zoonotic risks posed by other forms of animal industries. The geographic overlap between pig and poultry production is of particular concern, because the interplay between the two species heightens the risk of human influenza outbreak.

Generally speaking, animals in CAFOs have low levels of welfare and high levels of stress, which can reduce their ability to fight infection.⁵⁷⁴ As a result of this stress, animals engage in behaviors such as self-mutilation or cannibalism which may also increase the risk of transmission by creating open wounds, dispersing blood and other bodily fluids.⁵⁷⁵ Conditions in these facilities can be unsanitary, as live and dead animals are stored together along with their waste in enclosed rooms where the air is thick with ammonia. (Roughly 12,700 Americans die due to air pollution from livestock production each year, with ammonia particles from waste the dominant driver.⁵⁷⁶)

While this system of animal production has become increasingly mechanized, there are still several aspects of the production process that are performed by hand, all of which facilitate opportunities for disease transmission. In the pig industry, for example, semen collection and artificial insemination of sows are carried out manually, with or without gloves, allowing for direct contact with the animal as well as bodily fluids.⁵⁷⁷ Similarly, tail docking, castration, ear-marking, and teeth clipping—all of which are standard industry practice and generally not carried

The geographic overlap between pig and poultry production is of particular concern, because the interplay between the two species heightens the risk of human influenza outbreak.

570. Yaqiong Guo, Una Ryan, Yaoyu Feng, and Lihua Xiao, "Association of Common Zoonotic Pathogens With Concentrated Animal Feeding Operations," *Frontiers in Microbiology* 12 (2021): doi: 10.3389/fmicb.2021.810142.

571. Jay Graham, Jessica Leibler, Lance Price, et al., "The Animal-Human Interface and Infectious Disease in Industrial Food Animal Production: Rethinking Biosecurity and Biocontainment," *Public Health Reports* 123, No. 3 (2008) 282-299, <https://doi.org/10.1177/003335490812300309>.

572. A J Springbett, K MacKenzie, J A Woolliams, and S C Bishop, "The Contribution of Genetic Diversity to the Spread of Infectious Diseases in Livestock Populations," *Genetics* 165, No. 3 (November 2003): 1465-1474, doi: 10.1093/genetics/165.3.1465.

573. Michael Greger, *How to Survive a Pandemic* (New York: Flatiron Books, 2020), 421-22.

574. Mary Gilchrist, Christina Greko, David Wallinga, George Beran, et al., "The Potential Role of Concentrated Animal Feeding Operations in Infectious Disease Epidemics and Antibiotic Resistance," *Environmental Health Perspectives*, 115(2), (2007), 313-316, <https://doi.org/10.1289/ehp.8837>.

575. Elizabeth Overcash, "Detailed Discussion of Concentrated Animal Feeding Operations: Concerns and Current Legislation," *Animal Legal & Historical Center—Michigan State University College of Law*, 2011, <https://www.animallaw.info/article/detailed-discussion-concentrated-animal-feeding-operations>.

576. Nina Domingo, Srinidhi Balasubramanian, Sumil Thakrar, Michael Clark, et al., "Air Quality-Related Health Damages of Food," *Proceedings of the National Academy of Sciences* 118, No. 20 (May 18, 2021), <https://doi.org/10.1073/pnas.2013637118>.

577. R.V. Knox, "Artificial Insemination in Pigs Today," *Theriogenology* 85, No. 1 (January 1, 2016): 83-93, <https://doi.org/10.1016/j.theriogenology.2015.07.009>.

out by veterinarians or under anesthetic—can lead to contact with blood, saliva, or fecal matter as well as scratching or biting by animals seeking to escape.⁵⁷⁸ Runts, young piglets who are smaller than their siblings, are sometimes killed by hand. Each of these facets of the production process presents opportunities for zoonotic transmission to humans as well as disease spread within captive populations while similar high-risk touchpoints occur throughout cattle and poultry production as well. But, for producers, simply standing inside facilities that hold thousands of animals creates a risk in particular for pathogens that are transmitted through respiratory droplets and for airborne pathogens, just as standing in an amphitheater of infected persons would allow significant opportunities for exposure.⁵⁷⁹ Studies estimate that swine workers have a 30 times greater risk of zoonotic influenza infection than the general public.^{580 581 582}



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In some studies, the connection is even more pronounced. For example, research from the University of Iowa found a 54-fold increase in H1N1 influenza risk among those with exposure to pigs.⁵⁸³ Furthermore, even their non-swine-exposed spouses were at 28 times greater risk compared to individuals with no connection to the swine industry.⁵⁸⁴ However, despite this increased risk, livestock workers are not mentioned in annual influenza vaccine recommendations nor are they included on priority access lists for pandemic influenza vaccines.^{585 586}

Disease spread can occur anywhere along the chain of production. Both cows and pigs typically move through three different facilities before being transported to a fourth for slaughter. Under the current system, chickens may change hands up to five times, from farm flocks, wholesale dealers, poultry auctions, and retail markets before reaching the end-point consumer.⁵⁸⁷

578. Jeremy Marchant, Donald Lay Jr, Kimberly McMunn, et al., “Postnatal Piglet Husbandry Practices and Well-Being: The Effects of Alternative Techniques Delivered in Combination,” *Journal of Animal Science* 92, No. 3 (2014): 1150-1160, <https://doi-org.ezp-prod1.hul.harvard.edu/10.2527/jas.2013-6929>.
579. Jay Graham, Jessica H. Leibler, Lance B. Price, Joachim M. Otte, et al., “The Animal-Human Interface and Infectious Disease in Industrial Food Animal Production: Rethinking Biosecurity and Biocontainment,” *Public Health Rep* 123, No. 3 (May-June 2008): 287-299, doi: 10.1177/003335490812300309.
580. Kendall P. Myers, Christopher W. Olsen, Sharon F. Setterquist, Ana W. Capuano, et al., “Are Swine Workers in the United States at Increased Risk of Infection with Zoonotic Influenza Virus?” *Clinical Infectious Diseases* 42, No. 1, (January 1, 2006): 14–20, <https://doi.org/10.1086/498977>.
581. G Gray, T McCarthy, A Capuano, M LeBeck, et al., “Population-Based Surveillance for Zoonotic Influenza A Infections Among Agricultural Workers,” *American Journal of Epidemiology* 163, Suppl 11 (June 1, 2006): S195-S195, DOI: 10.1093/aje/163.suppl_11.S195-a.
582. Gregory C. Gray, Troy McCarthy, Ana W. Capuano, Sharon F. Setterquist, et al., “Swine Workers and Swine Influenza Virus Infections,” *Emerging Infectious Diseases* 13, No. 12 (December 2007): 1871-1878, doi: 10.3201/eid1312.061323.
583. Gregory C. Gray, Troy McCarthy, Ana W. Capuano, Sharon F. Setterquist, et al., “Swine Workers and Swine Influenza Virus Infections,” *Emerging Infectious Diseases* 13, No. 12 (December 2007): 1871-1878, doi: 10.3201/eid1312.061323.
584. Gregory C. Gray, Troy McCarthy, Ana W. Capuano, Sharon F. Setterquist, et al., “Swine Workers and Swine Influenza Virus Infections,” *Emerging Infectious Diseases* 13, No. 12 (December 2007): 1871-1878, doi: 10.3201/eid1312.061323.
585. Thomas C. Moore, Joseph Fong, Ayeisha M. Rosa Hernández, Kristen Pogreba-Brown, “CAFOs, Novel Influenza, and the Need for One Health Approaches,” *One Health* 13 (December 2021): doi 10.1016/j.onehlt.2021.100246.
586. Gregory C. Gray, Darrell W. Trampel, James A. Roth, “Pandemic Influenza Planning: Shouldn’t Swine and Poultry Workers Be Included?” *Vaccine* 25, No. 22 (May 30, 2007): 4376–4381, doi: 10.1016/j.vaccine.2007.03.036.
587. Ali Kahn, “The Next Pandemic: On the Front Lines Against Humankind’s Gravest Dangers,” (New York: Public Affairs, 2016), 153.

By transporting diseased animals, vehicles have also delivered and contributed to the spread of pathogens, occasionally resulting in outbreaks, and each movement has potential to introduce and spread new disease as animals are aggregated in greater numbers along the chain of production.⁵⁸⁸ Vertical integration in the poultry industry is common, such that a truck owned or other equipment used by a large producer may visit multiple facilities in one day, potentially spreading pathogens from one to another.⁵⁸⁹

Animals are transported by truck for slaughter at one of the more than 800 federally inspected livestock slaughter plants in the United States.⁵⁹⁰ According to an analysis of USDA data, roughly 20,000,000 chickens, 330,000 pigs, and 166,000 cows die during transport to slaughterhouses each year.⁵⁹¹ With animals dying from a range of different causes, including heat stress, cold, illness, and trauma, it may be difficult to assess which deaths are due to disease and to identify potential outbreaks. Once at the processing facility, workers stun the animal, and then hang the animal upside down, cut their throats, and process the parts into different cuts of meat.⁵⁹² This meat is then shipped to wholesalers, restaurants, retailers, and consumers.^{593 594}

Much of U.S. meat production is shipped for export to China, Japan, and Hong Kong, as well as to Mexico and Canada.⁵⁹⁵ Roughly 17% of U.S. poultry, 13% of U.S. beef, and 27% of U.S. pork is consumed outside the country.^{596 597 598} While these export markets carry commercial value more than \$20 billion in total, they also carry significant costs.⁵⁹⁹ Producing hundreds of millions of additional animals for export overseas means taking on additional zoonotic risks. At the same time, the United

By transporting diseased animals, vehicles have also delivered and contributed to the spread of pathogens...and each movement has potential to introduce and spread new disease as animals are aggregated in greater numbers along the chain of production.



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588. David Swayne, "Transcript of the Question and Answer Sessions from the Fifth International Symposium on Avian Influenza," *Avian Diseases* 47, s. 3 (2003): 1219-55, <https://doi.org/10.1637/0005-2086-47.s3.1219>.

589. Ali Khan and William Patrick, *The Next Pandemic: On the Front Lines Against Humankind's Gravest Dangers* (New York: Perseus Books, 2016).

590. "Cattle and Beef: Sector at a Glance," *USDA Economic Research Service*, last updated September 26, 2022, <https://www.ers.usda.gov/topics/animal-products/cattle-beef/sector-at-a-glance/>.

591. This figure includes animals who die upon arrival at the facility prior to slaughter. Many more animals—another 800,000 pigs, for example—arrive unable to walk. Sophie Kevany, "More than 20 million farm animals die on way to abattoir in the US each year," *The Guardian*, June 15, 2022, <https://www.theguardian.com/environment/2022/jun/15/more-than-20-million-farm-animals-die-on-way-to-abattoir-in-us-every-year>.

592. Poultry are hung before stunning takes place.

593. H. Russell Cross, "Livestock Slaughter Procedures," *Encyclopædia Britannica, Inc.*, accessed May 31, 2023, <https://www.britannica.com/technology/meat-processing/Preservation-and-storage>.

594. Carcasses are usually left in a cooler for 48 hours before meat cuts are prepared and sent out to retailers. "The Multi-Step Path to a Better U.S. Beef Supply Chain," *Natural Resources Defense Council*, accessed May 31, 2023, <https://www.nrdc.org/sites/default/files/better-beef-timeline.pdf>.

595. "Pork 2020 Export Highlights: Top Ten Export Markets for U.S. Pork," *USDA*, accessed May 31, 2023, <https://www.fas.usda.gov/pork-2020-export-highlights>.

596. "Poultry Sector at a Glance," *USDA Economic Research Service*, last modified June 13, 2022, <https://www.ers.usda.gov/topics/animal-products/poultry-eggs/sector-at-a-glance/>.

597. "The United States Meat Industry at a Glance," *North American Meat Institute*, accessed May 31, 2023, <https://www.meatinstitute.org/index.php?ht=d/sp/i/47465/pid/47465>.

598. James Mintert, "Exports More Important to Pork Than Beef or Chicken," *Purdue University Center for Commercial Agriculture*, September 22, 2021, <https://ag.purdue.edu/commercialag/home/resource/2021/09/exports-more-important-to-pork-than-beef-or-chicken/>.

599. Greg Henderson, "Beef Exports Exceed \$10 Billion, Pork Tops \$8 Billion," *Drovers.com*, Feb. 8, 2022, <https://www.drovers.com/news/industry/beef-exports-exceed-10-billion-pork-tops-8-billion>.

States also imports poultry, beef, and pork products in addition to live animals.

When particular diseases are detected in livestock, veterinarians are required to report them to state health officials, who relay those reports to the USDA.^{600 601} After an outbreak is confirmed, USDA's APHIS prepares a containment plan with steps that often include destroying animals who are infected or may have been exposed.⁶⁰² Producers are compensated by USDA indemnification payments for the loss of culled animals.⁶⁰³ However, when mass cullings of herds or flocks take place, safe disposal of such a large number of carcasses can present environmental challenges and secondary disease risks.

Of all of the pathogens examined in this report, influenzas are perceived by experts to be the most dangerous because of their pandemic potential, driven by their ability to reassort, mutate, and spread through droplets in the air.^{604 605} Wild aquatic birds are the natural reservoirs of avian influenzas and transmit the viruses to domestic poultry, who can then turn low-pathogenic strains to highly pathogenic strains, potentially spreading them to other species.⁶⁰⁶ Both chicken and hog facilities are particularly susceptible to viral influenza, with hogs acting as a potential bridge species capable of

passing avian influenza to humans and spawning new forms of disease.⁶⁰⁷ While recent prior outbreaks of avian influenza in humans have been rare and mostly limited to poultry workers, mortality was severe ranging from 30%–60%.⁶⁰⁸ Estimates project an influenza A pandemic could infect 30% of the world's population in a matter of months.^{609 610}

Of all of the pathogens examined in this report, influenzas are perceived by experts to be the most dangerous because of their pandemic potential, driven by their ability to reassort, mutate, and spread through droplets in the air.

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600. The USDA and most states provide a list of notifiable diseases. For the list of USDA reportable diseases, see "Notifiable Diseases and Conditions," *USDA Animal and Plant Health Inspection Service*, last updated June 13, 2022, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/nvap/Reference-Guide/Animal-Health-Emergency-Management/Notifiable-Diseases-and-Conditions>.
601. The USDA, in turn, notifies the World Organization for Animal Health (formerly OIE) if the outbreak involves specific kinds of pathogens. There are 117 OIE-listed diseases, though some notable diseases are not included on this list. "Animal Diseases," *OIE World Organisation for Animal Health*, accessed May 31, 2023, <https://www.oie.int/en/what-we-do/animal-health-and-welfare/animal-diseases/>.
602. "Development and Approval of Initial State Response and Containment Plans," *USDA Animal and Plant Health Inspection Service*, April 17, 2018, https://www.aphis.usda.gov/animal_health/animal_diseases/avian/downloads/vsg-8601.2-state-response-containment-plans.pdf.
603. "Procedures for Indemnity and Compensation Claims in Cases of H5/H7 LPAI in Poultry," *USDA Marketing and Regulatory Programs*, Animal and Plant Health Inspection Service, Veterinary Services, May 24, 2021, https://www.aphis.usda.gov/animal_health/animal_diseases/avian/downloads/vsg-8603.2-procedures-claims-h5h7-lpai-poultry.pdf.
604. Walter N. Harrington, Christina M. Kackos & Richard J. Webby, "The Evolution and Future of Influenza Pandemic Preparedness," *Experimental & Molecular Medicine* 53 (2021): 737–749, <https://doi.org/10.1038/s12276-021-00603-0>.
605. Yang Zhao, Brad Richardson, Eugene Takle, Lilong Chai, David Schmitt & Hongwei X, "Airborne Transmission May Have Played a Role in the Spread of 2015 Highly Pathogenic Avian Influenza Outbreaks in the United States," *Scientific Reports* 9, No. 11755 (2019): <https://doi.org/10.1038/s41598-019-47788-z>.
606. "What is the Difference Between Low Pathogenic and Highly Pathogenic Avian Influenza?" *U.S. Geological Survey*, accessed May 31, 2023, <https://www.usgs.gov/faqs/what-difference-between-low-pathogenic-and-highly-pathogenic-avian-influenza>.
607. Wenjun Ma, Robert E Kahn, and Juergen A Richt, "The Pig as a Mixing Vessel for Influenza Viruses: Human and Veterinary Implications," *Journal of Molecular and Genetic Medicine* 3, No. 1 (January 2009):158–166, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702078/>.
608. Walter N. Harrington, Christina M. Kackos & Richard J. Webby, "The Evolution and Future of Influenza Pandemic Preparedness," *Experimental & Molecular Medicine* 53 (2021): 737–749, <https://doi.org/10.1038/s12276-021-00603-0>.
609. Derek Gatherer, "The 2009 H1N1 Influenza Outbreak in its Historical Context," *Journal of Clinical Virology* 45, No. 3, (July 2009): 174-178, <https://doi.org/10.1016/j.jcv.2009.06.004>.
610. Jeffery K. Taubenberger and David M. Morens, "Influenza: The Once and Future Pandemic," *Public Health Rep.* 125, Suppl 3 (2010): 16-26, PMID: 20568566; PMCID: PMC2862331.

Several strains of influenza including H1N1, H1N2, H3N2, H5N1, and H7N9 have been circulating in U.S. pig and poultry facilities in recent years.



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Several strains of influenza including H1N1, H1N2, H3N2, H5N1, and H7N9 have been circulating in U.S. pig and poultry facilities in recent years.^{611 612} The impact of these diseases on both human and animal health is substantial.⁶¹³ The 2009 H1N1 “swine flu” epidemic is estimated to have hospitalized over 900,000 Americans—who presented with symptoms of fever, chills, and vomiting—in one of the largest disease outbreaks of recent record.⁶¹⁴ The virus, though it carried a relatively mild mortality rate compared to other strains, demonstrated the speed with which a novel influenza virus could travel through the United States, infecting over 60 million Americans in the first 12 months after emerging from a commercial hog farm.^{615 616 617} This outbreak has been linked to prior influenza strains found on North Carolina farms and elsewhere, demonstrating the difficulty of permanently eradicating these types of viruses.^{618 619} Spatiotemporal analysis of outbreak patterns during the 2009 epidemic showed increased risk in areas with high numbers of hog

production facilities, suggesting that animals in these facilities acted as amplifier reservoirs while the virus circulated in both pigs and humans.⁶²⁰

Since 2010, the USDA has tested over 120,000 samples from 33,000 swine for the presence of Influenza A Virus in swine (IAV-S). During this period, over 10,000 samples were positive for IAV-S.⁶²¹ Prior research from Iowa, the nation’s largest swine producing state, demonstrated higher prevalence of influenza viruses among individuals with occupational exposure to pigs, while another study showed

611. “Influenza in Swine,” *USDA*, accessed May 31, 2023, <https://www.usda.gov/topics/animals/one-health/influenza-swine>.

612. “Archived – Outbreaks of North American Lineage Avian Influenza Viruses,” *Centers for Disease Control and Prevention*, last updated December 10, 2018, <https://www.cdc.gov/flu/avianflu/north-american-lineage.htm>.

613. Many large-scale outbreaks occurred prior to this as well. For example, in 1983, avian influenza was identified in 448 flocks in Pennsylvania and Virginia and 17 million birds were destroyed to protect from further spread. Gerald Fichtner, “The Pennsylvania/Virginia Experience in Eradication of Avian Influenza (H5N2),” *Avian Diseases* 47 (2003): 33-38, <http://www.jstor.org/stable/3298724>.

614. “The Burden of the Influenza A H1N1pdm09 Virus Since the 2009 Pandemic,” *Centers for Disease Control and Prevention*, last updated June 10, 2019, <https://www.cdc.gov/flu/pandemic-resources/burden-of-h1n1.html>.

615. The outbreak spawned a novel wrongful death claim against Smithfield Pork brought by a Texas man, whose wife, at eight months pregnant, became the first person in the United States to die of the virus. The lawsuit accused Smithfield of creating conditions in hog facilities that fostered the spread of the H1N1 virus, raising questions as to whether producers may be held legally accountable for the creation or spread of zoonotic disease in the future. The precise origins of H1N1 remain fuzzy, though the general contours are more clear. Bryan Walsh, “H1N1 Virus: The First Legal Action Targets a Pig Farm,” *Time*, May 15, 2009, <http://content.time.com/time/health/article/0,8599,1898977,00.html>.

616. “2009 H1N1 Pandemic (H1N1pdm09 virus),” *Centers for Disease Control and Prevention*, last modified June 11, 2019, <https://www.cdc.gov/flu/pandemic-resources/2009-h1n1-pandemic.html>.

617. Gavin J. D. Smith, Dhanasekaran Vijaykrishna, Justin Bahl, Samantha J. Lycett et al, “Origins and Evolutionary Genomics of the 2009 Swine-Origin H1N1 Influenza A Epidemic,” *Nature* 459 (2009): 1122–1125, <https://www.nature.com/articles/nature08182>.

618. Benjamin Greenbaum and Raul Rabadan, “The Origin of the Recent Swine Influenza A(H1N1) Virus Infecting Humans,” *European Surveillance* 14, No. 17 (February 2009): <https://doi.org/10.2807/ese.14.17.19193-en>.

619. This 2009 influenza outbreak has also been linked genetically to the 1918 influenza pandemic. David M. Morens, Jeffery K. Taubenberger, Hillery A. Harvey, and Matthew J. Memoli, “The 1918 Influenza Pandemic: Lessons for 2009 and the Future,” *Critical Care Medicine* 38, No. 4 Suppl (April 2010): e10-e20, <https://doi.org/10.1097/CCM.0b013e3181ceb25b>.

620. Paul M. Lantos, Kate Hoffman, Michael Höhle, Benjamin Anderson, and Gregory C. Gray, “Are People Living Near Modern Swine Production Facilities at Increased Risk of Influenza Virus Infection?” *Clinical Infectious Diseases* 63, No. 12 (December 15, 2016): 1558-1563, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5146723/>.

621. “Influenza A Virus in Swine Surveillance Information,” *USDA Animal and Plant Health Inspection Service*, last updated February 10, 2023, https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/ah-expired-content/sa_swine_health/ct_siv_surveillance.

that the same was true of their spouses.^{622 623} Communities in areas surrounding CAFOs may themselves act as a springboard for viral influenza outbreaks; often such communities are poor and rural.⁶²⁴

Prior to 2022, the largest avian influenza outbreak of record occurred in 2014 and 2015, resulting in the loss of more than 50 million birds, most of them commercial laying hens, at a cost of \$3.3 billion.^{625 626 627} A few years later in 2017, a different influenza virus infected a Tyson farm in Tennessee. Despite killing 73,000 birds at that facility to contain the virus, the same strain was later found in commercial poultry flocks in neighboring Alabama, Kentucky, and Georgia.^{628 629}

In early 2022, another avian influenza outbreak (H5N1) marched across the Midwest, reaching 29 states and led to the culling of more than 35 million birds in just three months.⁶³⁰ By 2023, the outbreak spread to poultry in 47 states with over 58 million birds dead.⁶³¹ It has also infected more than a dozen different species of mammals from harbor seals in Maine to bottlenose dolphins in Florida to Kodiak bears in the Aleutian Islands of Alaska.⁶³² The CDC reported the first human case in the United States in April 2022. The virus jumped species to infect a man in Colorado who was assisting with depopulating diseased flocks.⁶³³ As of the time of this writing, however, there is no evidence of person-to-person spread inside the United States, though in some cases the virus appears to have obtained qualities that make it more transmissible to mammals, reigniting fears that H5N1 could spark a human pandemic.⁶³⁴



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622. Kendall P. Myers et al. "Are Swine Workers in the United States at Increased Risk of Infection with Zoonotic Influenza Virus?" *Clinical Infectious Diseases* 42, No. 1 (January 2006): 14-20, <https://doi.org/10.1086/498977>.

623. Gregory C. Gray, Gregory et al. "Swine Workers and Swine Influenza Virus Infections." *Emerging Infectious Diseases* 13, No. 12 (2007): 1871-8. doi:10.3201/eid1312.061323.

624. Roberto A. Saenz, Herbert W. Hethcote, and Gregory C. Gray. "Confined Animal Feeding Operations as Amplifiers of influenza," *Vector Borne and Zoonotic Diseases* 6, No. 4 (December 24, 2006): 338-46, <https://doi.org/10.1089/vbz.2006.6.338>.

625. Tom Polansek, "U.S. Chicken, Egg Companies Heighten Security After Bird Flu Case," *Reuters*, March 6, 2017, <https://www.reuters.com/article/us-health-birdflu-usa/u-s-chicken-egg-companies-heighten-security-after-bird-flu-case-idUSKBN16E01B>.

626. The USDA has established agreements with growers to compensate them for culled flocks. The 2002 outbreak was estimated to cost taxpayers close to \$120 million. The culling and disposal of flocks from the 2015 outbreak is estimated to have cost \$1 billion. Ali Khan and William Patrick, *The Next Pandemic: On the Front Lines Against Humankind's Gravest Dangers* (New York: Perseus Books, 2016).

627. Maryn McKenna, "Bird Flu Cost the US \$3.3 Billion and Worse Could Be Coming," *National Geographic*, July 15, 2015, <https://www.nationalgeographic.com/science/article/bird-flu-2>.

628. Sephanie Strom, "Bird Flu Outbreak Found at a Tennessee Farm," *The New York Times*, March 6, 2017 <https://www.nytimes.com/2017/03/06/dining/bird-flu-avian-influenza-chickens-tyson-foods.html>.

629. "Outbreaks of North American Lineage Avian Influenza Viruses," *Centers for Disease Control and Prevention*, last updated December 10, 2018, <https://www.cdc.gov/flu/avianflu/north-american-lineage.htm>.

630. Bill Chappell, "What We Know About the Deadliest U.S. Bird Flu Outbreak in 7 Years," *NPR*, April 6, 2022, <https://www.npr.org/2022/04/06/1091061758/bird-flu-outbreak>.

631. H5N1 Bird Flu: Current Situation Summary," *Centers for Disease Control and Prevention*, last updated May 3, 2023, <https://www.cdc.gov/flu/avianflu/avian-flu-summary.htm>.

632. "2022-2023 Detections of Highly Pathogenic Avian Influenza in Mammals," *USDA Animal and Plant Inspection Service*, last updated May 2, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-mammals>.

633. "U.S. Case of Human Avian Influenza A(H5) Virus Reported," *Centers for Disease Control and Prevention*, April 28, 2022, <https://www.cdc.gov/media/releases/2022/s0428-avian-flu.html>.

634. Kai Kupferschmidt, "Incredibly Concerning: Bird Flu Outbreak at Spanish Mink Farm Triggers Pandemic Fears," *Science*, January 24, 2023, <https://www.science.org/content/article/incredibly-concerning-bird-flu-outbreak-spanish-mink-farm-triggers-pandemic-fears>.

In addition to influenza viruses, CAFOs can be the source of more common forms of illness. Roughly 320,000 people in the United States suffer from salmonella infections resulting from the consumption of chicken and turkey.⁶³⁵ Industrial animal agriculture has also been associated with the a wide range of outbreaks such as hepatitis E virus, bovine tuberculosis, brucellosis, mad cow, Q fever, Escherichia coli O157:H7, Streptococcus suis, livestock-associated methicillin-resistant Staphylococcus aureus, and Cryptosporidium parvum in farm animals.⁶³⁶ Even when disease outbreaks in livestock do not spread to humans, their scale and economic impact can be substantial.^{637 638}

ANTIBIOTIC RESISTANCE

Antibiotic-resistant bacteria, strains of bacteria that cannot be treated through the use of antibiotics, present a significant and growing threat to public health. Antibiotic resistance occurs when bacteria adapt and continue to grow in the face of medications that once prevented them from spreading; this process is driven by overuse and improper use of antibiotics. Each year, in the United States, over 13 million pounds of medically significant antibiotics, approximately 65% of the total sales volume, are sold for use in farm animals.⁶³⁹

Antibiotics, generally intended to treat infections in humans, are instead fed prophylactically to livestock to prevent disease in densely-packed, high-volume production operations. In 2017, the FDA prohibited the use of medically significant antibiotics for the purpose of growth promotion in livestock.⁶⁴⁰ However, this has done little to stem the overuse as producers continue using large quantities of such drugs prophylactically to similar ends. They are sometimes administered indiscriminately to whole herds of animals in feed or in water. A third of antibiotics approved for use in agriculture can be administered for excessively long or undefined periods of time.⁶⁴¹ Such applications contribute to overuse and drive the development of antibiotic resistance.

Antibiotic-resistant bacteria can enter the human body when people eat contaminated meat or animal products. They can also spread from fans in livestock houses or from manure spread on fields as fertilizer, washing down into lakes and rivers. Past studies have found that 71% of pork chops at supermarkets in the United States carried antibiotic-resistant bacteria, 79% of ground turkey, 36% of chicken breasts, and 62% of ground beef.⁶⁴²

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- 635. "Foodborne Illness Source Attribution Estimates for 2019 for Salmonella, Escherichia coli O157, Listeria monocytogenes and Campylobacter Using Multi-Year Outbreak Surveillance Data, United States," *Interagency Food Safety Analytics Collaboration*: U.S. Department of Health and Human Services' Centers for Disease Control and Prevention, U.S. Food and Drug Administration, and U.S. Department of Agriculture's Food Safety and Inspection Service, October 2021, <https://www.cdc.gov/foodsafety/ifsac/pdf/P19-2019-report-TriAgency-508.pdf>.
- 636. Yaqiong Guo, Una Ryan, Yaoyu Feng, and Lihua Xiao, "Association of Common Zoonotic Pathogens With Concentrated Animal Feeding Operations," *Frontiers in Microbiology* 12 (January 10, 2022): <https://doi.org/10.3389/fmicb.2021.810142>.
- 637. Other diseases such as the highly contagious African swine fever threaten devastating economic losses to livestock producers if they reach the United States. As of the first half of 2023, African swine fever is making its way through the Caribbean just 700 miles from Miami while the USDA, for its part, has committed \$500 million to stopping the virus from reaching American farms. If it does, estimates predict it would cause up to \$50 billion in damages, along with 140,000 lost jobs. Miguel Carriquiry, Amani Elobeid, David Swenson, Dermot Hayes, "Impacts of African Swine Fever in Iowa and the United States," *Center for Agricultural and Rural Development Iowa State University*, (March 2020), <https://www.card.iastate.edu/products/publications/pdf/20wp600.pdf>. See also: "U.S.D.A monitoring discovery of African Swine Fever in Caribbean," *Radiolowa*, February 15, 2022, <https://www.radioiowa.com/2022/02/15/u-s-d-a-monitoring-discovery-of-african-swine-fever-in-caribbean/> and Tom Polansek, "U.S. Pledges Up To \$500 Million to Prevent African Swine Fever," *Reuters*, September 29, 2021, <https://www.reuters.com/article/us-usa-swine-fever/u-s-pledges-up-to-500-million-to-prevent-african-swine-fever-idUSKBN2GP1SQ>.
- 638. African swine fever, for example, is extremely deadly to animals, with mortality on some farms approaching 100%. However, the virus is not transmissible to humans in its current form. Natasha N. Gaudreault, Daniel W. Madden, William C. Wilson, Jessie D. Trujillo and Juergen A. Richt, "African Swine Fever Virus: An Emerging DNA Arbovirus," *Frontiers in Veterinary Science* (May 13, 2020): <https://www.frontiersin.org/articles/10.3389/fvets.2020.00215/full>.
- 639. The FDA is responsible for tracking antibiotic use on farms but only does so by tracking sales data. Farms are not required to provide use data and do so only voluntarily, preventing the government from having a clear picture of antibiotic use. "2021 Summary Report on Antimicrobials Sold or Distributed for Use in Food-Producing Animals," *FDA*, December 2022, <https://www.fda.gov/media/163739/download>.
- 640. "Timeline of FDA Action on Antimicrobial Resistance," *U.S. Food and Drug Administration*, last updated April 28, 2023, <https://www.fda.gov/animal-veterinary/antimicrobial-resistance/timeline-fda-action-antimicrobial-resistance>.
- 641. "FDA Must Establish Limits for All Animal Antibiotics," *Pew Charitable Trusts*, April 29, 2021, <https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2021/04/fda-must-establish-limits-for-all-animal-antibiotics>.
- 642. "Report: Superbugs Found in More Than Three-Fourths of U.S. Supermarket Meat," *Environmental Working Group*, June 28, 2018, <https://www.ewg.org/news-insights/news-release/report-superbugs-found-more-three-fourths-us-supermarket-meat>.

ANTIBIOTIC RESISTANCE (Continued)

Each year, at least 23,000 Americans die and some 2 million are sickened by antibiotic-resistant bacterial infections resulting from exposure to such tainted meat, at a cost to the healthcare system of over \$2 billion.^{643 644 645 646}

Even so, very little is known about antibiotic use in the livestock industry. Neither the USDA nor the FDA nor the CDC tracks or monitors antibiotic use.⁶⁴⁷ Data is extremely scarce. When outbreaks do occur, agency response is limited by both a lack of political will and by an industry that is resistant to regulation of antibiotic use.

When 192 people became seriously ill after eating pork contaminated with an antibiotic-resistant strain of salmonella at a pig roast in Washington, for example, public health investigators from the CDC and the USDA were blocked by farm owners and industry groups from inspecting farms where the outbreak began.^{648 649} Without access to the production facilities that raise animals and administer these antibiotics, public officials cannot trace outbreaks back to their source, initiate recalls, or advise on safer practices. As a result, health officials lack even the most basic information about on-farm use of antibiotics and the prevalence of antibiotic-resistant pathogens at such facilities.⁶⁵⁰ In an interview with *The New York Times*, a former chief veterinarian at the USDA's Food Safety and Inspection Service stated that the pork industry regularly blocked the release of information regarding antibiotic use, noting, "When it comes to power, no one dares to stand up to the pork industry, not even the U.S. government."⁶⁵¹

Apart from direct transmission of pathogens, overuse of antibiotics in CAFOs also presents serious risks to public health. Antibiotic drugs are fed to animals to prevent and treat illness, often caused by poor living conditions, as well as to stimulate their growth.⁶⁵² While federal law sets maximum allowable levels of drug residue for meat sold for human consumption, it does relatively little to curb the overuse of medically significant antibiotics in animal agriculture.⁶⁵³ This overuse, in turn, encourages the development of antibiotic-resistant pathogens, such that the livestock industry not only creates zoonotic disease exposure but also undermines the human health system's ability to treat some of those same diseases.⁶⁵⁴

Antibiotic drugs are fed to animals to prevent and treat illness, often caused by poor living conditions, as well as to stimulate their growth.

643. "Antibiotics and Animal Agriculture: A Primer," *Pew Charitable Trusts*, December 19, 2016, <https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2016/12/antibiotics-and-animal-agriculture-a-primer>.
644. Gabriel K. Innes, Pranay R. Randad, Anton Korinek, et al., "External Societal Costs of Antimicrobial Resistance in Humans Attributable to Antimicrobial Use in Livestock," *Annu Rev Public Health* 41 (April 2, 2020): 141-157, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7199423/>.
645. Livestock employees and their families are at the greatest risk of antibiotic-resistant infection. Studies have found that workers at hog facilities were six times more likely to carry multidrug-resistant staph infections (including "MRSA") than the general public, while their children were twice as likely as other children to carry these same diseases. Shylo E. Wardyn, Brett M. Forshey, Sarah A. Farina, et al., "Swine Farming Is a Risk Factor for Infection With and High Prevalence of Carriage of Multidrug-Resistant *Staphylococcus aureus*," *Clinical Infectious Diseases* 61, No. 1, (July 2015): 59–66, <https://doi.org/10.1093/cid/civ234>.
646. Sarah M. Hatcher, Sarah M. Rhodes, Jill R. Stewart, et al., "The Prevalence of Antibiotic-Resistant *Staphylococcus aureus* Nasal Carriage among Industrial Hog Operation Workers, Community Residents, and Children Living in Their Households: North Carolina, USA," *Environmental Health Perspectives* 125, No. 4 (April 2017): 560-569, <https://doi.org/10.1289/EHP35>.
647. The FDA collects sales data on antibiotics but does not collect data related to use. Because of this, it is unknown exactly what is being used, at what rate, and for what purpose. USDA APHIS has done a handful of self-reported surveys, but these are done infrequently and only at the species level.
648. Matt Richtel, "Tainted Pork, Ill Consumers and an Investigation Thwarted," *The New York Times*, August 4, 2019, <https://www.nytimes.com/2019/08/04/health/pork-antibiotic-resistance-salmonella.html>.
649. Vance M. Kawakami, Lyndsay Bottichio, Kristina Angelo, et al., "Notes from the Field: Outbreak of Multidrug-Resistant Salmonella Infections Linked to Pork – Washington, 2015," *CDC Morbidity and Mortality Weekly Report* 65, No. 14 (April 15, 2016): 379-381, <https://www.cdc.gov/mmwr/volumes/65/wr/mm6514a4.htm>.
650. Matt Richtel, "Tainted Pork, Ill Consumers and an Investigation Thwarted," *The New York Times*, August 4, 2019, <https://www.nytimes.com/2019/08/04/health/pork-antibiotic-resistance-salmonella.html>.
651. Matt Richtel, "Tainted Pork, Ill Consumers and an Investigation Thwarted," *The New York Times*, August 4, 2019, <https://www.nytimes.com/2019/08/04/health/pork-antibiotic-resistance-salmonella.html>.
652. While there have been federal restrictions imposed to curb the latter, it is still common practice, with little means to distinguish between these dual motivations.
653. 21 C.F.R. § 556.
654. Tsepo Ramatla, Lubanza Ngoma, Modupeade Adetunji, and Mulunda Mwanza, "Evaluation of Antibiotic Residues in Raw Meat Using Different Analytical Methods," *Antibiotics* 6, No. 4 (December 2017): 34, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5745477/>.

CAFOs can also drive environmental damage that undermines public health and presents broad risks of disease transmission.⁶⁵⁵ Dangerous pathogens can be released through waste and other forms of pollution that affect groundwater and neighboring populations.⁶⁵⁶ In 2019, the Iowa Department of Natural Resources announced that more than half of the state's rivers, lakes, and wetlands failed to meet required water quality standards due, in large part, to pollution from the state's overwhelming number of industrial farms.⁶⁵⁷



At the federal level, CAFOs are regulated and monitored by EPA and USDA APHIS, an agency that enforces legislation related to biosecurity measures, slaughtering protocols, and food safety regulations. The USDA's Food Safety and Inspection Services Division (FSIS) and the FDA share responsibility for ensuring that livestock animal products are safe for human consumption. The USDA is also responsible for inspecting imported live livestock at the border to prevent foreign animal diseases from entering into the U.S. food system. FSIS inspectors conduct pre and post-mortem visual inspections of animals at slaughter. Some but not all communicable diseases can be diagnosed by visual inspection alone. Animals who exhibit outward symptoms of specific diseases, such as tuberculosis, are separated from the rest of the herd.^{658 659} However, removing animals on an individual basis for displaying symptoms of infectious disease overlooks the fact that other members of the herd have also been exposed to the infected animal. In addition, the brevity of these inspections may severely limit their effectiveness, as each FSIS inspector must inspect more than 600 animals per hour, nearly 25,000 animals per week.^{660 661} These concerns may become more pressing as line speeds at processing plants continue to accelerate. At poultry plants,

chickens are killed and processed at speeds of up to 175 birds per minute.⁶⁶² Assessing an animal's health status at these speeds is extremely challenging and expecting inspectors to sustain these rates of inspection over an extended period of time may be unrealistic.⁶⁶³

655. The EPA estimates that livestock account for 49% of all agricultural greenhouse gas emissions; however, this estimate does not include the emissions from growing crops that are used to feed livestock. Together, livestock and livestock feed account for almost 80% of all agricultural greenhouse gas emissions in the United States. Livestock production is also the single greatest contributor to methane emissions, a super pollutant that is 80 times more potent than CO₂ over a 20 year time horizon. "Greenhouse Gas Emissions Inventory Data Explorer 1990-2021," last updated April 20, 2023, <https://cfpub.epa.gov/ghgdata/inventoryexplorer/#agriculture/entiresector/allgas/category/all>; Peter H. Lehner and Nathan A. Rosenberg, *Farming for Our Future: The Science, Law, and Policy of Climate-Neutral Agriculture* (Washington, D.C.: Environmental Law Institute, 2021), 44.

656. Carrie Hribar, "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities," *National Association of Local Boards of Health 2*, accessed May 31, 2023, https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf.

657. "2018 305(b) Assessment Summary: 2018 Integrated Report including the 2018 Impaired Waters List," *Iowa Department of Natural Resources*, March 24, 2020, <https://programs.iowadnr.gov/adbnnet/Assessments/Summary/2018>.

658. Ante-Mortem Livestock Inspection," *USDA FSIS Directive 6100.1, Rev 3*, May 7, 2022, https://www.fsis.usda.gov/sites/default/files/media_file/2020-07/6100.1.pdf.

659. In 2019, USDA FSIS implemented an option for voluntary segregation of swine and sheep before ante mortem inspection such that an establishment may voluntarily segregate abnormal animals to facilitate the scheduling of animals for slaughter. "Livestock Ante Mortem Inspection," *USDA FSIS*, July 2, 2019, https://www.fsis.usda.gov/sites/default/files/media_file/2021-11/17a_HQ_LSIIT_Antemortem_07-02-2019.pdf.

660. "Slaughter Inspection 101," *USDA Food Safety and Inspection Service*, last updated August 9, 2013, <https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/slaughter-inspection-101>.

661. "Livestock Slaughter Annual Summary," *USDA Economics, Statistics, and Market Information System*, April 29, 2023, <https://usda.library.cornell.edu/concern/publications/r207tp32d>.

662. "FSIS Announces Study of Effect of Increased Poultry Line Speeds on Worker Safety," *USDA Food Inspection and Safety Services*, Constituent Update, July 29, 2022, <https://www.fsis.usda.gov/news-events/news-press-releases/constituent-update-july-29-2022>.

663. For comparison, imagine, for example, a doctor, who has three patients flash before her eyes for one second, and then disappear. The doctor can neither touch nor test them, but has only this third of a second to assess them for diseases, including asymptomatic ones.

At present, there is no universal disease testing of livestock in the United States. The USDA does, however, operate specific sampling and certification programs for particular diseases at the population level. APHIS has a sampling program for livestock, while FSIS has a sampling program for raw meats.^{664 665}

At present, there is no universal disease testing of livestock in the United States.

Oversight of factory farms themselves is limited. Regulators may lack basic information about how many operations exist and where.⁶⁶⁶ Surveying aerial photographs in 2017, Iowa's Department of Natural Resources found 4,200 previously unknown facilities in Iowa alone, a state with 80 million farm animals and just three million people.⁶⁶⁷ Prior attempts by the Environmental Protection Agency to inventory and locate factory farms were abandoned following a string of lawsuits from the livestock industry.⁶⁶⁸



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An overwhelming majority of the regulation governing large-scale animal agriculture applies only to the last stages of production—slaughter, processing, and cold storage.^{669 670} As a result, greater risks for zoonotic spread may occur upstream in the supply chain. For the vast majority of an animal's life, until they are loaded for transport to slaughter, there are virtually no laws governing their living conditions, welfare, or treatment. CAFOs are not physically inspected, and the USDA maintains that it does not have

664. "Resources for Conducting Animal Health Surveillance," *USDA APHIS*, last updated June 2, 2020, https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/monitoring-and-surveillance/sa_nahss/ct_resources.

665. "Food Safety and Inspection Service Annual Sampling Program Plan Fiscal Year 2022," *USDA FSIS*, accessed May 31, 2023, https://www.fsis.usda.gov/sites/default/files/media_file/2021-12/FSIS-Annual-Sampling-Plan-FY2022.pdf.

666. This may be especially true of animal feeding operations ("AFOs") that fall just below the numbers thresholds required to meet the definition of a "CAFO."

667. "Factory Farms Provide Abundant Food, But Environment Suffers," *PBS NewsHour*, Feb. 6, 2020, <https://www.pbs.org/newshour/economy/factory-farms-provide-abundant-food-but-environment-suffers>.

668. "The EPA's Failure to Track Family Farms," *Food and Water Watch*, Aug. 2013, https://foodandwaterwatch.org/wp-content/uploads/2021/03/EPA-Factory-Farms-IB-Aug-2013_0.pdf.

669. The Humane Methods of Slaughter Act regulates the treatment of food animals at the time of slaughter. Animals covered by this Act include cattle, calves, sheep, swine, goats, horses, mules, and other equines. The Act was originally passed on August 27, 1958 and is enforced by USDA's FSIS. "Humane Methods of Slaughter Act," *USDA National Agriculture Library*, accessed May 31, 2023, <https://www.nal.usda.gov/animal-health-and-welfare/humane-methods-slaughter-act>.

670. The Poultry Products Inspection Act regulates the slaughter of poultry. "Poultry Products Inspection Act," *USDA Food Safety and Inspection Service*, accessed May 31, 2023, <https://www.fsis.usda.gov/policy/food-safety-acts/poultry-products-inspection-act>.

authority to carry out on-site inspections of these facilities.^{671 672 673} Livestock handling is functionally exempt from state animal cruelty laws and there is little else governing human-animal interactions at these facilities.^{674 675}

Intense biosecurity goes hand-in-hand with a lack of transparency at these facilities that are closed to the public, journalists, and regulators.

Many industrial animal agricultural operations do, however, have higher levels of biosecurity than other industries. Access to these facilities is tightly controlled. Sealing off these operations and keeping animals entirely indoors can reduce the frequency but increase the magnitude of disease outbreaks. Intense biosecurity goes hand-in-hand with a lack of transparency at these facilities that are closed to the public, journalists, and regulators, such that much of what is known of conditions in CAFOs comes through private undercover investigations or whistleblowers.⁶⁷⁶ Still, the ongoing H5N1 influenza outbreaks demonstrate that even with strict biosecurity protections in place and advanced warning about impending disease, many producers are still unable to prevent infection.

12. Livestock Auctions

In livestock auctions, domestic animals are consigned for sale to bidders through public auction.⁶⁷⁷ Approximately 10.4 million livestock animals are sold annually through online or physical auctions, representing an annual revenue of close to \$6.2 billion.⁶⁷⁸ Livestock commonly sold at these auctions include cattle, pigs, sheep, goats, horses, donkeys, and mules. In person auctions typically take place in large barns and consist of livestock offered for sale by many different farms. Animals are presented in the auction ring, offered either individually or as lots, weighed, and sold to the highest bidder. Online auctions (including live webcams of physical auctions) have increased in number in the last five years, dramatically expanding the audience reach.



671. By contrast, the FDA does inspect dairy facilities. The FDA has primary authority to regulate dairy and seafood while the USDA oversees other traditional livestock species. USDA and FDA share authority at various points in the meat and animal product supply chains. These divisions can be confusing. In the case of eggs, for example, the FDA governs whole eggs in the shell while the USDA governs packaged egg whites.

672. Why Doesn't the United States Department of Agriculture Do More to Protect the Welfare of Farm Animals? *USDA Have a Question? AskUSDA*, last updated April 28, 2020, <https://ask.usda.gov/s/article/Why-doesnt-the-United-States-Department-of-Agriculture-do-more-to-protect-the-welfare-of-farm-animals>.

673. Cynthia Brougher, "USDA Authority to Regulate On-Farm Activity," *Congressional Research Service*, Report R40577, May 12, 2009, https://www.everycrsreport.com/files/20090512_R40577_6b8d3e6d6fa98602296460753656690cdcc4163d.pdf.

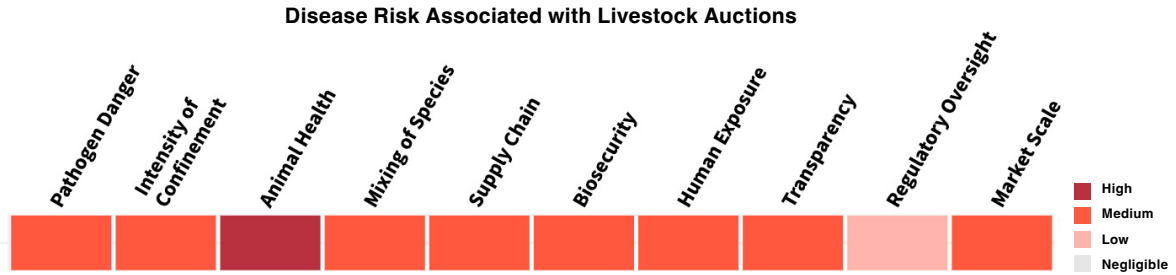
674. Certain states such as Texas and Iowa exempt livestock animals from cruelty laws altogether.

675. Some state laws impose minimum space requirements for housing certain types of animals. For example, see California's Proposition 12, the Farm Animal Confinement Initiative (2018), Title 3, California Code of Regulations (3 CCR), sections 1320-1326 (2022).

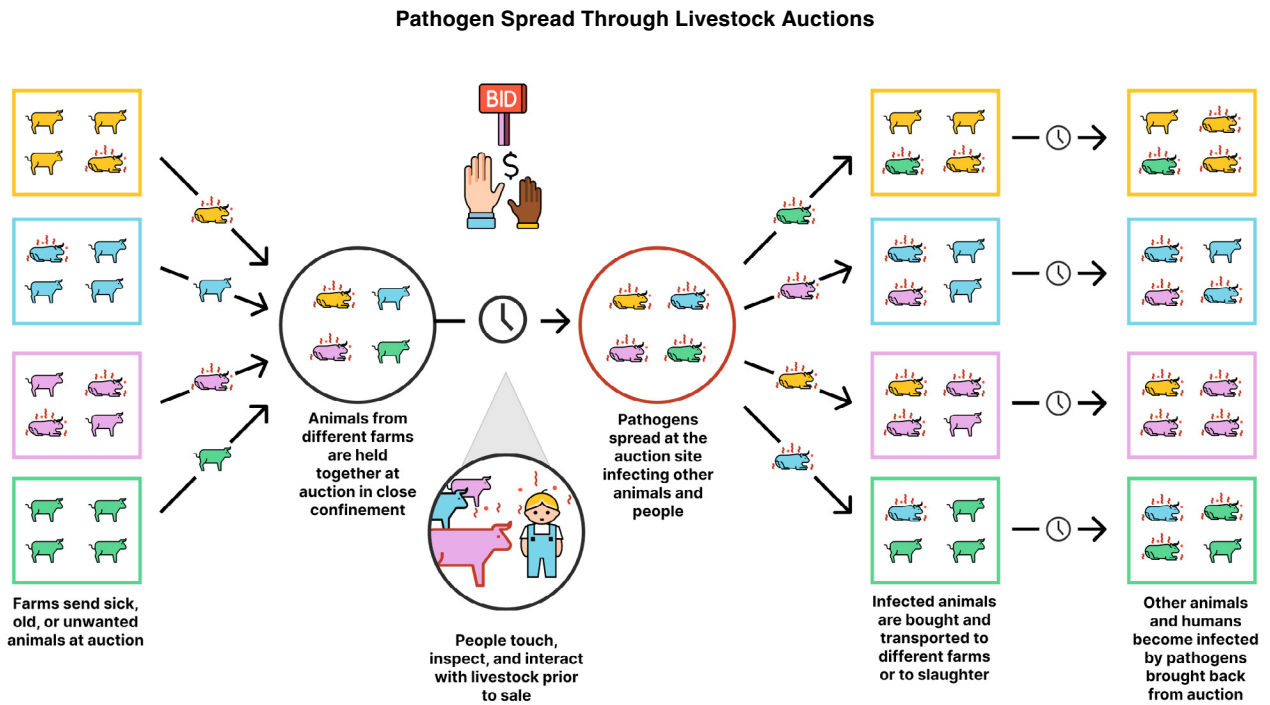
676. Several states have passed so-called "Ag-gag" laws, which impose criminal penalties for documenting animal agricultural operations. These anti-whistleblower laws are one means by which industry has taken steps to insulate itself from public view.

677. Ingrid C. Garrison and Lindsey Martin, "Disease Prevention for Fairs and Festivals, 2019 Report," *Kansas Department of Health and Environment*, May 9, 2019, http://nasphv.org/Documents/Public_settings_toolkit/DiseasePreventionForFairsToolkit_Kansas2019.pdf.

678. The USDA reports that 96% of animals sold are sold through physical auctions as opposed to online auctions. However, the USDA only tracks some fraction of the total number of livestock auctions that take place and this estimate may not accurately reflect the current distribution. "National Feeder & Stocker Cattle Summary, week ending May 21, 2022," *USDA-MO Dept of Ag Market News*, May 23, 2022, https://www.ams.usda.gov/mnreports/sj_ls850.txt. Annualized number of animals sold extrapolated from weekly total. Annual revenue based on average of current market prices as of April 7, 2021.



Livestock auctions can broadly be broken into two categories: “productive markets” and “cull markets.” In the former, animals are sold for their productive value, i.e., their value while alive, while in the latter, animals are sold for their value at slaughter.⁶⁷⁹ Animals presented at auctions come from many different places, sometimes travel long distances for sale, and often include less-valued, young, old, or sickly animals sold at discounted prices. Some die in transport or at the auction site. These animals come to one centralized location where they are held in close quarters with other such animals before being sold, and subsequently dispersed to other farms where they may bring any pathogens they carry back to infect existing herds (or to slaughterhouses).⁶⁸⁰



Several aspects of livestock auctions facilitate transmission of zoonotic disease through close contact between humans and animals. Before the auction begins, attendees (often including children) are welcomed back to touch and inspect the animals in their holding pens.⁶⁸¹ Direct interactions with

679. Animals sold at cull auctions often include young cattle, pigs, sheep, goats, and birds bred specifically for slaughter as well as “spent” animals who were once valued for their reproductive capacity but who have been deemed economically inefficient. These animals are typically either transported directly to slaughterhouses or moved to a feedlot or farm to be fattened before slaughter. Kathryn Gillespie, *The Cow with Ear Tag #1389* (Chicago: University of Chicago Press, 2018), 94.

680. “What is the Livestock Auction Process?” *Texas Farm and Ranch Solution, LLC.*, accessed May 31, 2023, <https://txfrs.com/livestock-auction-process/>.

681. Kathryn Gillespie, *The Cow with Ear Tag #1389* (Chicago: University of Chicago Press, 2018).

live animals, such as these, can and have given rise to zoonotic transmission.^{682 683} Moreover, because auctions are generally held on a weekly basis, with limited biosecurity, pathogens may survive week to week and infect the next round of animals held in the same physical structures of the auction house.⁶⁸⁴ In some cases, auctions take place daily. A certificate of veterinary inspection is often required at larger auctions but may be overlooked at smaller ones or those that source animals exclusively from within the state.⁶⁸⁵ Inclusion of animals who may have been exposed to wildlife heightens the disease risk, as it increases the risk of introducing pathogens endemic to wild animals that have potential to mix and propagate among farmed animals.⁶⁸⁶ Bringing animals from a variety of sources as well as a variety of species and holding them together as they wait allows pathogens to spread from one animal to the next, as does bringing each into a central ring for sale where pathogens may linger in the wood shavings or dirt floor.^{687 688} Further opportunities for transmission arise when infected animals sold at auction are loaded up and transported back to farms where they may spread disease to workers or other livestock.⁶⁸⁹ In addition, if buyers slaughter the animals they purchase from auction for personal consumption, they generally may do so themselves on their own property with no licensing or inspection requirements.⁶⁹⁰



Despite the disease risks inherent in livestock auctions, there is often a lack of sanitation and transparency. Journalists and photographers are sometimes not allowed to document certain portions—sometimes any portions—of the auction. Additionally, lack of recordkeeping means that it may be very difficult to trace and control a disease outbreak sourced from a livestock auction. *Salmonella*, *E. Coli*, and *Coxiella burnetii* (the pathogen that causes Q fever) are some of the bacterial risks at livestock auctions; the effects of these may be mild but can be life-threatening.⁶⁹¹ Other common zoonotic diseases found in and around livestock auctions include brucellosis, influenza, leptospirosis, and psittacosis.⁶⁹²

Livestock auctions are very lightly regulated. The USDA does require a certified veterinary inspection for all livestock transported interstate, however, and some states have additional inspection and identification requirements to help prevent disease spread across state

682. Ioannis Magouras et al., “Emerging Zoonotic Diseases: Should We Rethink the Animal–Human Interface?,” *Frontiers in Veterinary Science* 7 (October 22, 2020).
683. Gijs Klous, Anke Huss, Dick Heederik, and Roel Coutinho, “Human–Livestock Contacts and Their Relationship to Transmission of Zoonotic Pathogens, a Systematic Review of Literature,” *One Health* 2 (December 2016): 65–76, <https://doi.org/10.1016/j.onehlt.2016.03.001>.
684. Kathryn Gillespie, *The Cow with Ear Tag #1389* (Chicago: University of Chicago Press, 2018).
685. “Livestock show preparation: The importance of a Certificate of Veterinary Inspection,” *Oklahoma State University News and Media*, February 16, 2023, <https://news.okstate.edu/articles/veterinary-medicine/2023/livestock-show-preparation-cvi.html>.
686. Marco Liverani, Jeff Waage, Tony Barnett, Dirk U. Pfeiffer et al., “Understanding and Managing Zoonotic Risk in the New Livestock Industries,” *Environmental Health Perspectives* 121, No. 8 (August 2013): 873–77, <https://doi.org/10.1289/ehp.1206001>.
687. Muhammad Tanveer Munir, H el ene Pailhories, Matthieu Eveillard, and Mark Irle, “Testing the Antimicrobial Characteristics of Wood Materials: A Review of Methods,” *Antibiotics* 9, No. 5 (May 2020): 225, doi: 10.3390/antibiotics9050225.
688. Felicia Keesinga and Richard S. Ostfeld, “Impacts of Biodiversity and Biodiversity Loss on Zoonotic Diseases,” *Proc Natl Acad Sci U S A*. 118, No. 17 (April 27, 2021): 118, <https://doi.org/10.1073/pnas.2023540118/>.
689. Marco Liverani, Jeff Waage, Tony Barnett, Dirk U. Pfeiffer et al., “Understanding and Managing Zoonotic Risk in the New Livestock Industries,” *Environmental Health Perspectives* 121, No. 8 (August 2013): 873–877, <https://doi.org/10.1289/ehp.1206001>.
690. “Exemptions from Inspection Requirements,” 21 U.S. Code § 623, <https://www.law.cornell.edu/uscode/text/21/623>.
691. Gilbert J. Kersh, Teresa M. Wolfe, Kelly A. Fitzpatrick, Amanda J. Candee et al., “Presence of *Coxiella burnetii* DNA in the Environment of the United States, 2006 to 2008,” *Applied and Environmental Biology* 76, No. 13 (July 1, 2010): <https://journals.asm.org/doi/full/10.1128/AEM.00042-10>.
692. J. LeJeune and A. Kersting, “Zoonoses: An Occupational Hazard for Livestock Workers and a Public Health Concern for Rural Communities,” *Journal of Agricultural Safety and Health* 16, No. 3 (2010): 161–179, <https://pubmed.ncbi.nlm.nih.gov/20836437/>.

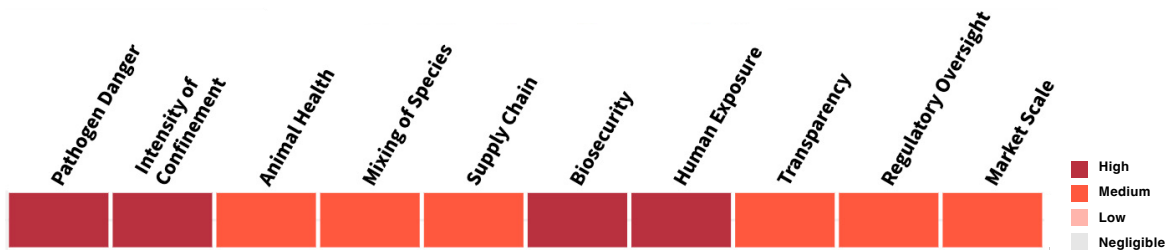
lines, though there is little oversight of intrastate sale of animals.^{693 694} Regulation is largely left to state and local discretion, and enforcement is inconsistent. Where health inspections do occur, the quantity of animals sold and the rapidity required of those inspections often allow only cursory appraisals. Some states have imposed minimal welfare regulations, for example, requiring that animals sold for slaughter are killed within five days of sale. These measures, however, do little to address disease risk.⁶⁹⁵

13. Live Animal Markets

Live animal markets in the United States are typically retail food markets where animals are stored alive and sold to consumers for the purpose of human consumption.⁶⁹⁶ Animals in some cases may be sold alive but are more often freshly killed and butchered on site. Species sold at these markets include poultry (predominantly chickens, ducks, and quails, and less frequently pigeons, squabs, geese, turkeys, guinea fowls, peacocks, partridges, and pheasants), mammals (predominantly rabbits, pigs, calves, sheep, and goats), fishes, and other aquatic animals (predominantly frogs, turtles, and crustaceans).^{697 698 699} Many live animal markets sell only poultry, though they typically offer a wide variety of bird species. In New York City, roughly one-quarter of these markets also slaughter large livestock.⁷⁰⁰



Disease Risk Associated with Live Animal Markets



Hundreds of such markets operate across the United States, some of which may sell and process thousands of animals per week.⁷⁰¹ The USDA estimates that more than 25 million birds of different species pass through 130 known live bird markets in the Northeast alone each year.⁷⁰²

693. 9 CFR Parts 71-89, <https://www.law.cornell.edu/cfr/text/9/part-71>.

694. For example, see Massachusetts state requirements: "Importing and Exporting Livestock," Massachusetts Department of Agricultural Resources, accessed May 31, 2023, <https://www.mass.gov/info-details/importing-and-exporting-livestock>.

695. Animal Industry Act, M. C. L. A. 287.701–747.

696. "Live Animal Markets," Cal. Penal Code § 597.3 § (2019).

697. Poultry in the United States is considered any domesticated bird used for food. "What Is Poultry?" *USDA*, last updated March 1, 2023, <https://ask.usda.gov/s/article/What-is-poultry>.

698. Lindsey Garber, Laurel Voelker, George Hill, and Judith Rodriguez, "Description of Live Poultry Markets in the United States and Factors Associated with Repeated Presence of H5/H7 Low-Pathogenicity Avian Influenza Virus," *Avian Diseases* 51, No. s1 (March 2007): 417-420, <https://doi.org/10.1637/7571-033106R.1>.

699. Robert G Webster, "Wet Markets—a Continuing Source of Severe Acute Respiratory Syndrome and Influenza?," *The Lancet* 363, No. 9404 (January 17, 2004): 234-236, [https://doi.org/10.1016/S0140-6736\(03\)15329-9](https://doi.org/10.1016/S0140-6736(03)15329-9).

700. Anne Barnard, "Meeting, Then Eating, The Goat," *The New York Times*, May 24, 2009, <https://www.nytimes.com/2009/05/25/nyregion/25slaughter.html>.

701. Lindsey Garber, Laurel Voelker, George Hill, and Judith Rodriguez, "Description of Live Poultry Markets in the United States and Factors Associated with Repeated Presence of H5/H7 Low-Pathogenicity Avian Influenza Virus," *Avian Diseases* 51, No. s1 (March 2007): 417-420, <https://doi.org/10.1637/7571-033106R.1>.

702. Jarra F. Jagne, Joy Bennett and Eireann Collins, "Live Bird Markets of the Northeastern United States," *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.

Live animal markets generally sell to individual households for personal consumption. Market clientele are culturally diverse, though often predominately made up of members from Asian-American, Latinx, Jewish, and Muslim communities.⁷⁰³ These markets are considered to be particularly important to immigrant communities for cultural and religious reasons such as obtaining animals that were slaughtered in a particular way. This is especially true in the New York City boroughs which are home to over 80 live animal markets.⁷⁰⁴

Many characteristics of live animal markets make them especially vulnerable to outbreaks of zoonotic disease. Generally, animals are kept at high densities under poor conditions. While the proximity of animals to one another facilitates contagion, limited air flow and hygiene can also promote pathogen spread.⁷⁰⁵ These conditions also induce stress, which may cause animals to shed viruses at higher levels or make them more susceptible to infection.^{706 707 708} With birds packed densely in stacked cages, feces, urine, and blood travel downward from one cage to the next. Some live animal markets in the United States tend to be cleaned and disinfected irregularly and insufficiently.⁷⁰⁹ The wooden chopping blocks that are used for slaughter and butchering are of particular concern in facilitating disease spread.⁷¹⁰ Disposal also presents risks, with reports of gutted carcasses and blood being improperly discarded, sometimes left in public spaces in open trash cans.⁷¹¹

The movements of the animals into and within live animal markets are another relevant factor in disease transmission. Producers sell to wholesale dealers and haulers who bring the animals to live animal markets and sell them to shop owners.⁷¹² Animals may come from a variety of sources, including CAFOs. For example, in Pennsylvania, live animal markets acquired poultry from an average of almost 30 different sources.⁷¹³ Often, there is significant carryover of animals from one day to the next, with some animals remaining on site for weeks, allowing pathogens to persist despite any regular cleaning.⁷¹⁴

With birds packed densely in stacked cages, feces, urine, and blood travel downward from one cage to the next.

703. Yingjie Wang, "LA's 'Wet Markets' Could Be On The Chopping Block," *LAist*, July 9, 2020, <https://laist.com/news/food/la-wet-markets-chopping-block-city-officials-proposed-ban-coronavirus>.
704. Danielle Leigh, "Coronavirus News: Mounting Calls to Close Live Animal Markets amid COVID-19," *ABC7NY*, April 15, 2020, <https://abc7ny.com/nyc-slaughterhouses-live-markets-coronavirus-update/6105833/>.
705. The Humane Society of the United States, "An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza," *Impact of Animal Agriculture*, 9 (2007): https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.
706. A. Alonso Aguirre, Richard Catherina, Hailey Frye, and Louise Shelley, "Illicit Wildlife Trade, Wet Markets, and COVID-19: Preventing Future Pandemics," *World Medical and Health Policy* 12, No. 3 (September 2020): 256-265, <https://doi.org/10.1002/wmh3.348>.
707. Emily M. Hall, Jesse L. Brunner, Brandon Hutzenbiler, and Erica J. Crespi, "Salinity Stress Increases the Severity of Ranavirus Epidemics in Amphibian Populations," *Proc Biol Sci*. 287, No. 1926 (May 13, 2020): 287, <https://doi.org/10.1098/rspb.2020.0062>.
708. David A. Padgett 1 and Ronald Glaser, "How Stress Influences the Immune Response," *Trends in Immunology* 24, No. 8 (August 2003): 444-448.
709. Lindsey Garber, Laurel Voelker, George Hill, and Judith Rodriguez, "Description of Live Poultry Markets in the United States and Factors Associated with Repeated Presence of H5/H7 Low-Pathogenicity Avian Influenza Virus," *Avian Diseases* 51, No. s1 (March 2007): 417-420, <https://doi.org/10.1637/7571-033106R.1>.
710. Man Ying Lo, Wing Yui Ngan, Shue Man Tsun, Huey-Leng Hsing, et al., "A Field Study Into Hong Kong's Wet Markets: Raised Questions Into the Hygienic Maintenance of Meat Contact Surfaces and the Dissemination of Microorganisms Associated With Nosocomial Infections," *Frontiers in Microbiology* 10 (November 12, 2019): 2618, <https://doi.org/10.3389/fmicb.2019.02618>.
711. "Here's What Goes on Inside America's Wet Markets," *NowThis News*, YouTube, July 22, 2020, https://www.youtube.com/watch?v=kM1L_voE6WU.
712. Jarra F. Jagne, Joy Bennett and Eireann Collins, "Live Bird Markets of the Northeastern United States," *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.
713. Jarra F. Jagne, Joy Bennett and Eireann Collins, "Live Bird Markets of the Northeastern United States," *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.
714. Robert Webster, "Wet Markets—A Continuing Source of Severe Acute Respiratory Syndrome and Influenza?" *The Lancet* 363, No. 9404 (January 17, 2004): 234-236, [https://doi.org/10.1016/S0140-6736\(03\)15329-9](https://doi.org/10.1016/S0140-6736(03)15329-9).

RELIGIOUS SLAUGHTER AND SACRIFICE

Religious slaughter and animal sacrifice take many forms in the United States. The most common forms of religious slaughter are Halal and Kosher, which delimit rules for Muslim and Jewish consumers of certain food products, including meat.⁷¹⁵ Halal and Kosher slaughter in some cases operate on a smaller scale than most meat-processing in the United States. Halal and Kosher slaughterhouses generally source their animals from the same places as the rest of the industry, although they may rely more on livestock auctions and live animal food markets, which can increase the likelihood of disease transmission.⁷¹⁶ Because these specialized slaughter facilities may be located proximate to the communities they serve, and individual consumers may be allowed in very close proximity to the live animals, their ability to transmit zoonotic disease is further heightened. Some of these religious activities are enabled through exemptions in the Poultry Products Inspection Act (PPIA) as well as FSIS Directives and the Humane Methods of Slaughter Act.^{717 718}

Within the United States, sacrificial slaughter is most commonly practiced under the auspices of Judaism, Islam, and the Afro-Caribbean religions of Santeria and Palo Mayombe.⁷¹⁹ While many forms of sacrificial slaughter pose heightened zoonotic disease risk due to a lack of biosecurity and oversight, perhaps the most significant risk comes from the Jewish practice of Kaporos (Kapparot), which occurs at a larger scale than other events.

Each year in New York City alone, Kaporos practitioners sacrifice an estimated 60,000 chickens in public streets over the course of a few days before the onset of Yom Kippur.⁷²⁰ Practitioners are expected to directly handle the birds before and during slaughter. The quantity of those interactions, as well as the resultant biofluids such as blood and excrement that can contaminate public streets, make this form of sacrificial slaughter particularly high-risk for public health.⁷²¹

In the Islamic tradition, the most common form of sacrificial slaughter occurs during Eid al-Adha, an important Islamic holiday observed by slaughtering an animal, usually a goat, a sheep, a cow, or a camel.⁷²² In Minnesota, for example, hundreds of Muslim observers travel to farms where practitioners can select from pens the animal that they would like to sacrifice. Customers at these farms sometimes perform the sacrificial killing themselves or sometimes with the assistance of an employee.⁷²³



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715. "Kosher and Halal," Texas A&M Agrilife Extension, accessed June 2, 2022, <https://meat.tamu.edu/ansc-307-honors/kosher-halal/>.
716. Mahmoud Naguib, Ruiyun Li, Jiaxin Ling, DeliaGrace et al, "Live and Wet Markets: Food Access versus the Risk of Disease Emergence," *Trends in Microbiology* 29, No. 7 (July 2021): 573-581, <https://doi.org/10.1016/j.tim.2021.02.007>.
717. "Guidance for Determining Whether a Poultry Slaughter or Processing Operation is Exempt from Inspection Requirements of the Poultry Products Inspection Act," *USDA FSIS*, Guideline ID FSIS-GD-2006-0001, April 2006, https://www.fsis.usda.gov/sites/default/files/import/Poultry_Slaughter_Exemption_0406.pdf.
718. "Ante-Mortem Livestock Inspection," *USDA FSIS Directive* 6100.1, Rev 3, May 7, 2022, https://www.fsis.usda.gov/sites/default/files/media_file/2020-07/6100.1.pdf.
719. Jose A. Lammoglia, "Legal Aspects of Animal Sacrifice Within the Context of Afro-Caribbean Religions," *St. Thomas Law Review* 20, No. 710 (2008): <https://www.animallaw.info/article/legal-aspects-animal-sacrifice-within-context-afro-caribbean-religions>.
720. Donny Moss, "60,000 Chickens Are Swung and Slaughtered on Public Streets During Ritual Sacrifice," *Their Turn*, October 10, 2017, <https://theirturn.net/2017/10/06/kaporos-chicken-massacre/>.
721. Donny Moss, "Kaporos, Largest Live Animal Wet Market in the United States, Opens Ahead of Yom Kippur," *Their Turn*, September 19, 2020, <https://theirturn.net/2020/09/19/kaporos-wet-markets-yom-kippur/>.
722. Mustafa Akyol, "Why Do Muslims Slaughter Animals for God?," *The New York Times*, August 21, 2018, <https://www.nytimes.com/2018/08/21/opinion/eid-al-adha-sacrifice-isaac.html>.
723. Ibrahim Hers, "A Goat, a Knife, a Sacrifice: Some Muslims in Minnesota Celebrate Eid al Adha Holiday With Ritual Slaughter," *Sahan Journal*, July 21, 2020, <https://sahanjournal.com/eid-al-adha/minnesota-eid-al-adha-halal-farm-slaughter>.

Daily introduction of new animals into this environment provides optimal conditions to introduce new infectious diseases such as influenza.⁷²⁴ Even when markets are deep cleaned, disinfected, left empty for days, and repopulated with animals from closely monitored sources, however, disease has been found to return to markets within a matter of weeks.⁷²⁵ Moreover, the very act of cleaning can diffuse pathogens into the environment via sewage and waterways, enabling pathogens to spread beyond market walls if done improperly.⁷²⁶

These high-risk conditions common across live animal markets can be exacerbated by several other factors. For example, many live animal markets sell a diversity of species including birds, mammals, reptiles, fish, and amphibians. As a result, live animal markets bring together pathogens from different taxonomic origins and provide them an ideal venue to mix and mutate.⁷²⁷ Some of these markets also sell animals alive for consumers to take home and kill themselves, enabling pathogens to spread and move beyond the confines of a market and creating concerns as to where and how the slaughter is taking place.^{728 729} This threat is also present when unsold animals from live animal food markets are sent back to nearby farms.⁷³⁰ Even when animals are no longer present, transport trucks that ferry empty crates back and forth to farms have been found to carry disease.⁷³¹

The dominant disease risk from live poultry markets is influenza. Live bird markets are particularly high-risk in this respect because they often combine waterfowl—the natural reservoirs of influenza—with chickens and other poultry who can become infected and potentially spread the virus to other animals and humans. While industrial production facilities raise only one species, live bird markets mix many, and in doing so, they threaten to create versions of the virus that can be introduced back to industrial poultry producers. For example, live poultry markets have been implicated in past outbreaks of H5N2, which led to the culling of 17 million chickens at a cost of \$400 million.^{732 733} In 2004, another outbreak of H5N2 occurred in Texas after a

The dominant disease risk from live poultry markets is influenza. Live bird markets are particularly high-risk in this respect because they often combine waterfowl—the natural reservoirs of influenza—with chickens and other poultry who can become infected and potentially spread the virus to other animals and humans.

724. Robert Webster, “Wet Markets—A Continuing Source of Severe Acute Respiratory Syndrome and Influenza?” *The Lancet* 363, No. 9404 (January 17, 2004): 234-236, [https://doi.org/10.1016/S0140-6736\(03\)15329-9](https://doi.org/10.1016/S0140-6736(03)15329-9).

725. It is unknown whether cleaning practices were ineffective and the virus somehow persisted, or if it was reintroduced. The Humane Society of the United States, “An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza,” *Impact of Animal Agriculture* 9 (2007), https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.

726. Hui Liu, Zongqiu Chen, Xincan Xiao, Jianyun Lu, et al., “Effects of Resting Days on Live Poultry Markets in Controlling the Avian Influenza Pollution,” *Zhonghua Liu Xing Bing Xue Za Zhi* 35, No. 7 (July 2014): 832-836, <https://pubmed.ncbi.nlm.nih.gov/25294077/>.

727. A. Alonso Aguirre, Richard Catherina, Hailey Frye, and Louise Shelley, “Illicit Wildlife Trade, Wet Markets, and COVID-19: Preventing Future Pandemics,” *World Medical and Health Policy* 12, No. 3 (September 2020): 256-265, <https://doi.org/10.1002/wmh3.348>.

728. Lindsey Garber, Laurel Voelker, George Hill, and Judith Rodriguez, “Description of Live Poultry Markets in the United States and Factors Associated with Repeated Presence of H5/H7 Low-Pathogenicity Avian Influenza Virus,” *Avian Diseases* 51, No. s1 (March 2007): 417-420, <https://doi.org/10.1637/7571-033106B.1>.

729. Carol Cardona, Karen Yee, and Tim Carpenter, “Are Live Bird Markets Reservoirs of Avian Influenza?” *Poultry Science* 88, No. 4 (May 2009): 856-859, <https://doi.org/10.3382/ps.2008-00338>.

730. The Humane Society of the United States, “An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza,” *Impact of Animal Agriculture* 9 (2007), https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.

731. Jarra F. Jagne, Joy Bennett, and Eireann Collins, “Live-Bird Markets in the Northeastern United States,” *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.

732. The Humane Society of the United States, “An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza,” *Impact of Animal Agriculture* 9 (2007), https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.

733. D. J. Alexander, “A Review of Avian Influenza in Different Bird Species,” *Veterinary Microbiology* 74, No. 1-2 (May 22, 2020): 3-13, [https://doi.org/10.1016/S0378-1135\(00\)00160-7](https://doi.org/10.1016/S0378-1135(00)00160-7).



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producer introduced a chicken from a live poultry market in Houston to his flock of 7,000 birds.⁷³⁴ Outbreaks at facilities in Delaware and Maryland of a different strain, H7N2, are also thought to have come from live poultry markets where the pathogens traveled on crates or trucks that were not properly disinfected between loads.^{735 736} Given the potential risks that live bird markets pose in terms of igniting outbreaks among poultry, some producers are determined to eliminate these operations for fear that they may jeopardize the poultry industry writ large and endanger public health.⁷³⁷ The risk of influenza transmission to humans is particularly acute in markets that contain both pigs and poultry, two important carriers of influenza viruses.

A detailed study of pigs in two live animal food markets in Minneapolis found high rates of influenza viruses not just in and on the animals themselves, but in the air and on surfaces throughout the market.⁷³⁸ At these markets, which brought in between 80-200 new pigs per week, 47% of the pigs were found to carry influenza virus at the time they were slaughtered. Fifty-three percent of air samples taken from above the pig holding pen also tested positive for the virus.⁷³⁹ In addition, 47% of the railings and bars of the pen indicated the presence of influenza. The virus was also found on door knobs, on the faucet, and in the sink.⁷⁴⁰ The study also found strong evidence indicating that the virus spilled over in the markets from pigs to humans. Sixty-five percent of the workers who participated in the study tested positive for influenza virus during the 12 week period of study; 41% tested positive on multiple occasions. In addition, a customer, a twelve-year old boy, who touched the railings of the swine pen as well as a live pig, also became infected.^{741 742 743} Over the 12 week course of study, researchers observed the virus change rapidly as it cycled through the animals within the confines of the markets, developing “new constellations of gene segments” and leading to the creation of “new viruses,” that had not been documented in those markets before.⁷⁴⁴

734. Chang-Won Lee, David E. Swayne, Jose A. Linares, Dennis A. Senne, et al. “H5N2 Avian Influenza Outbreak in Texas in 2004: the First Highly Pathogenic Strain in the United States in 20 Years?” *Journal of Virology* 79, No. 17 (September 2005): 11412-11421, <https://doi.org/10.1128/JVI.79.17.11412-11421.2005>.

735. D.A. Senne, J.C. Pederson, and B. Panigrahy, “Live-Bird Markets in the Northeastern United States: A Source of Avian Influenza in Commercial Poultry,” eds. R.S. Schrijver and G. Koch, *Proceedings of the Frontis Workshop on Avian Influenza: Prevention and Control* (2003: Wageningen, The Netherlands): 19-24.

736. David Swayne, Transcript of the Question and Answer Sessions from the Fifth International Symposium on Avian Influenza,” *Avian Diseases* 47, s3 (September 1, 2003): 1219-55, <https://doi.org/10.1637/0005-2086-47.s3.1219>.

737. Simon Shane, “Live-Bird Markets Are Under the Microscope,” *National Provisioner*, April 1, 2004, <https://www.provisioneronline.com/articles/94286-live-bird-markets-are-under-the-microscope-1>.

738. Mary J. Choi, Montserrat Torremorell, Jeff B. Bender, Kirk Smith, et al., “Live Animal Markets in Minnesota: A Potential Source for Emergence of Novel Influenza A Viruses and Interspecies Transmission,” *Clinical Infectious Diseases* 61, No. 9, (November 2015): 1355-1362, <https://doi.org/10.1093/cid/civ618>.

739. Mary J. Choi, Montserrat Torremorell, Jeff B. Bender, Kirk Smith, et al., “Live Animal Markets in Minnesota: A Potential Source for Emergence of Novel Influenza A Viruses and Interspecies Transmission,” *Clinical Infectious Diseases* 61, No. 9, (November 2015): 1355-1362, <https://doi.org/10.1093/cid/civ618>.

740. Mary J. Choi, Montserrat Torremorell, Jeff B. Bender, Kirk Smith, et al., “Live Animal Markets in Minnesota: A Potential Source for Emergence of Novel Influenza A Viruses and Interspecies Transmission,” *Clinical Infectious Diseases* 61, No. 9, (November 2015): 1355-1362, <https://doi.org/10.1093/cid/civ618>.

741. Mary J. Choi, Montserrat Torremorell, Jeff B. Bender, Kirk Smith, et al., “Live Animal Markets in Minnesota: A Potential Source for Emergence of Novel Influenza A Viruses and Interspecies Transmission,” *Clinical Infectious Diseases* 61, No. 9, (November 2015): 1355-1362, <https://doi.org/10.1093/cid/civ618>.

742. Many of the infected workers did not exhibit symptoms, suggesting that these kinds of infections may often spread asymptotically without being noticed or diagnosed.

743. The authors note that “employees were frequently being exposed to a variety of IAVs present in the air,” but importantly, the pigs were also exposed to human-origin influenza viruses through close interspecies contact at the markets, allowing for possible transmission in both directions. Only one of the 17 employees who participated in the study had been vaccinated against seasonal influenza.

744. Mary J. Choi, Montserrat Torremorell, Jeff B. Bender, Kirk Smith, et al., “Live Animal Markets in Minnesota: A Potential Source for Emergence of Novel Influenza A Viruses and Interspecies Transmission,” *Clinical Infectious Diseases* 61, No. 9, (November 2015): 1355-1362, <https://doi.org/10.1093/cid/civ618>.

These results, and others like them, highlight the danger of zoonotic spillover at live animal food markets in the United States. But they also demonstrate how the ways in which these markets operate can amplify the risk and showcase the ability of influenza viruses to generate new and potentially dangerous forms.

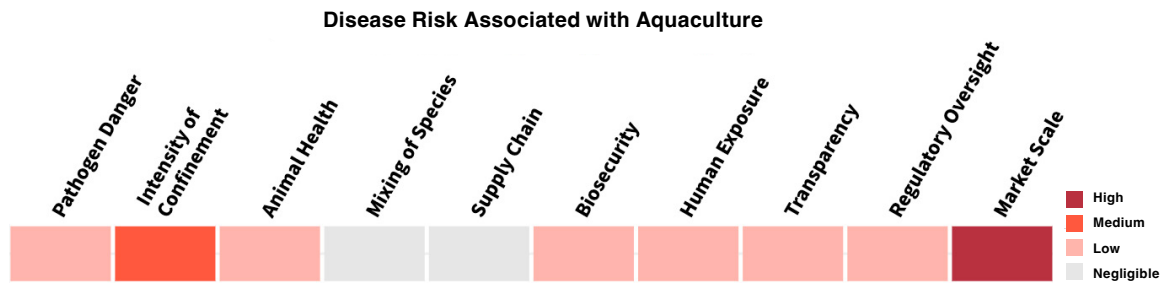
Currently most of the regulation of live animal poultry markets—including inspection and licensing—is carried out at the state level.⁷⁴⁵ The USDA only regulates the sale of cows, sheep, pigs, and goats at live markets.⁷⁴⁶ The USDA has published voluntary guidelines, however, for preventing avian influenza in live bird markets and all states currently employ these guidelines, which include monthly testing for avian influenza viruses of randomly selected flock members.^{747 748} With these guidelines in place since 2003, the presence of H5 or H7 strains in New York live bird markets fell dramatically from 60%–80% of those tested in the early 2000s to none in 2019.^{749 750} Prior to these guidelines, studies found that less than 2% of live bird markets followed recommended biosecurity and handling practices.⁷⁵¹ Despite these improvements, disease risks remain.^{752 753} In the first four months of 2023, there were six outbreaks of H5N1 at live bird markets in the United States, occurring in New York, Florida, and Virginia.⁷⁵⁴ Many of these markets were located in densely urban areas and contained up to 1,400 birds.⁷⁵⁵

The process of selling live animals for on-demand slaughter came under increased scrutiny in the United States during the COVID-19 pandemic due to potential connections between the virus and the Huanan Seafood Market, a live animal market in China. In light of public health concerns, Utah banned live bird markets in 2020, and during the same year, New York extended a four-year moratorium on live animal markets within 1,500 feet of residential buildings.^{756 757 758}

745. The Humane Society of the United States, “An HSUS Report: Human Health Implications of U.S. Live Bird Markets in the Spread of Avian Influenza,” *Impact of Animal Agriculture* 9 (2007), https://www.wellbeingintlstudiesrepository.org/hsus_reps_environment_and_human_health/9.
746. Anne Barnard, “Meeting, Then Eating, The Goat,” *The New York Times*, May 24, 2009, <https://www.nytimes.com/2009/05/25/nyregion/25slaughter.html>.
747. “Prevention and Control of H5 and H7 Avian Influenza in the Live Bird Marketing System Uniform Standards for a State-Federal-Industry Cooperative Program,” *USDA Animal and Plant Health Inspection Service Veterinary Services*, APHIS 91-55-076, last updated August 2020, https://www.aphis.usda.gov/animal_health/animal_dis_spec/poultry/downloads/lbms_program_standards_final.pdf.
748. Jarra F. Jagne, Joy Bennett, and Eireann Collins, “Live-Bird Markets in the Northeastern United States,” *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.
749. Jarra F. Jagne, Joy Bennett, and Eireann Collins, “Live-Bird Markets in the Northeastern United States,” *Delaware Journal of Public Health* 7, No. 1 (January 2021): 52-56, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8352538/>.
750. DA Senne, JC Pederson, and B Panigrahy. “Live-Bird Markets in the Northeastern United States: A Source of Avian Influenza in Commercial Poultry,” in: Schrijver RS and Koch G (eds.), *Proceedings of the Frontis Workshop on Avian Influenza: Prevention and Control* (Wageningen, The Netherlands, 2003), 19-24.
751. L.L. Bulaga, L. Garber L, D. Senne, et al. “Descriptive and Surveillance Studies of Suppliers to New York and New Jersey Retail Live-Bird Markets,” *Avian Diseases* 47, (2003): 1169-76. <https://pubmed.ncbi.nlm.nih.gov/14575136/>.
752. Prior to the ongoing H5N1 outbreak, three states—New Jersey, New York, and Pennsylvania—detected low pathogenic H5 avian influenza at live animal poultry markets in recent years. Lisa Schnirring, “Three States Report Low-Path H5 at Live-Bird Markets,” *Center for Infectious Disease Research and Policy*, University of Minnesota, July 12, 2016, <https://www.cidrap.umn.edu/news-perspective/2016/07/three-states-report-low-path-h5-live-bird-markets>.
753. In 2020, the USDA launched a surveillance, sanitation, and regulatory-measures program called the “Prevention and Control of H5 and H7 Avian Influenza in the Live Bird Marketing System: Uniform Standards for a State-Federal-Industry Cooperative Program.” Though the program is voluntary and managed by the states, some part of the program is now used by all the states. Under this program, sites can be inspected randomly by state animal health inspectors during unannounced inspections. “Prevention and Control of H5 and H7 Avian Influenza in the Live Bird Marketing System Uniform Standards for a State-Federal-Industry Cooperative Program,” *USDA Animal and Plant Health Inspection Service Veterinary Services*, APHIS 91-55-076, last modified August 2020, https://www.aphis.usda.gov/animal_health/animal_dis_spec/poultry/downloads/lbms_program_standards_final.pdf.
754. “2022-2023 Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks,” *USDA Animal and Plant Inspection Services*, last updated May 8, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-commercial-backyard-flocks>.
755. “2022-2023 Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks,” *USDA Animal and Plant Inspection Services*, last updated May 8, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-commercial-backyard-flocks>.
756. “Release of Gamebirds and Prohibition of Live Bird Markets,” Utah Admin. Code 58-6-7 (2020).
757. Katherine Donlevy, “Legislation to Close NY Slaughterhouses,” *Queens Chronicle*, August 13, 2020, https://www.qchron.com/editions/queenswide/legislation-to-close-ny-slaughterhouses/article_ec6eb168-0fd9-527c-b2ec-decbdb6457b6f.html.
758. Stricter bills have been introduced in New York, Rhode Island, and California, but nothing has yet passed into law.

14. Aquaculture

Aquaculture, the practice of farming of aquatic animals in captive or controlled aquatic environments, is a \$2.7 billion annual market, encompassing 4,100 fish farms in the United States.^{759 760} The process often attempts to insulate the fish from predators, pests, and disease to increase yield rates. Fish raised for human consumption, including catfish, perch, salmon, hybrid striped bass, tilapia, and trout account for approximately 60% of the aquaculture market with ornamental fish, such as koi and tropical fish, baitfish, and sportfish making up most of the rest.⁷⁶¹ The majority of U.S. production focuses on freshwater species.⁷⁶² Freshwater crawfish, shrimp, and mollusk species such as oysters, clams, and mussels are also produced in large numbers. Yet, despite this significant market size, the United States remains a relatively minor player in the global aquaculture industry overall, ranking 17th in total production.⁷⁶³



Aquaculture is regulated at both the federal and state level. The EPA is responsible for wastewater permitting across all industries, while the FDA covers food safety regulations. State and local governments generally oversee permitting or licensing at the community level. Permits often deal with zoning, building, water use, and waste discharge. Laws and regulations governing aquaculture vary among different states and can also vary considerably between geographic locations within a state. The majority of applicable controls have an environmental focus, while relatively few address public health.

There are a number of zoonotic diseases present in farmed fishing operations; however, the overall risk posed to humans from aquaculture is relatively low. There have been reports of fish handlers contracting bacteria such as *Vibrio vulnificus*, *Streptococcus iniae*, and *Edwardsiella tarda*.⁷⁶⁴ More often, people are infected through the consumption of raw or undercooked fish containing Salmonella or parasites such as trematode, cestode, and nematode parasites.⁷⁶⁵ As sushi and raw fish products have become more popular in recent years, illnesses caused by these parasites have increased accordingly.⁷⁶⁶

759. John Madigan, "Fish & Seafood Aquaculture in the US.," *IBISWorld*, Industry Report 11251, December 2021.

760. "Global Aquaculture Industry," *ReportLinker*, February 2022, <https://www.reportlinker.com/p05443599/Global-Aquaculture-Industry.html>.

761. "Aquaculture: An Overview," *The National Agricultural Law Center*, accessed May 31, 2023, <https://nationalaglawcenter.org/overview/aquaculture/>.

762. "2020 Fisheries of the United States," *NOAA National Marine Fisheries Service Office of Science and Technology Fisheries Statistics Division*, May 2022, <https://media.fisheries.noaa.gov/2022-05/Fisheries-of-the-United-States-2020-Report-FINAL.pdf>.

763. "US Aquaculture," *NOAA Fisheries*, last updated September 20, 2022, <https://www.fisheries.noaa.gov/national/aquaculture/us-aquaculture>.

764. Malcolm Weir, Andrijana Rajić, Lucie Dutil, Carl Uhland, et al., "Zoonotic Bacteria and Antimicrobial Resistance in Aquaculture: Opportunities for Surveillance in Canada," *The Canadian Veterinary Journal* 53, No. 6 (June 2012): 619-622, <https://pubmed.ncbi.nlm.nih.gov/23204579/>.

765. Carlos A.M. Lima dos Santos and Peter Howgate, "Fishborne Zoonotic Parasites and Aquaculture: A Review," *Aquaculture* 318, No. 3-4 (August 2011): 253-261, <https://doi.org/10.1016/j.aquaculture.2011.05.046>.

766. Michelle Ma, "'Sushi Parasites' Have Increased 283-Fold In Past 40 Years," *University of Washington News*, March 19, 2020, <https://www.washington.edu/news/2020/03/19/sushi-parasites-have-increased-283-fold-in-past-40-years/>.

Given the risk that disease outbreak poses to farmed fish producers, even without regulatory mandates, some have chosen to reduce disease risk by investing in vaccines, probiotics, higher-quality diets, limited culture density, and antibiotics, all of which may help to prevent disease in controlled environments.⁷⁶⁷ However, use of antibiotics in aquaculture also poses the same risks of creating antibiotic resistant strains of bacteria as with terrestrial species.⁷⁶⁸



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767. Ayalew Assefa and Fufa Abunna, "Maintenance of Fish Health in Aquaculture: Review of Epidemiological Approaches for Prevention and Control of Infectious Disease of Fish," *Veterinary Medicine International* 2018, No. 5432497 (2018): <https://doi.org/10.1155/2018/5432497>.

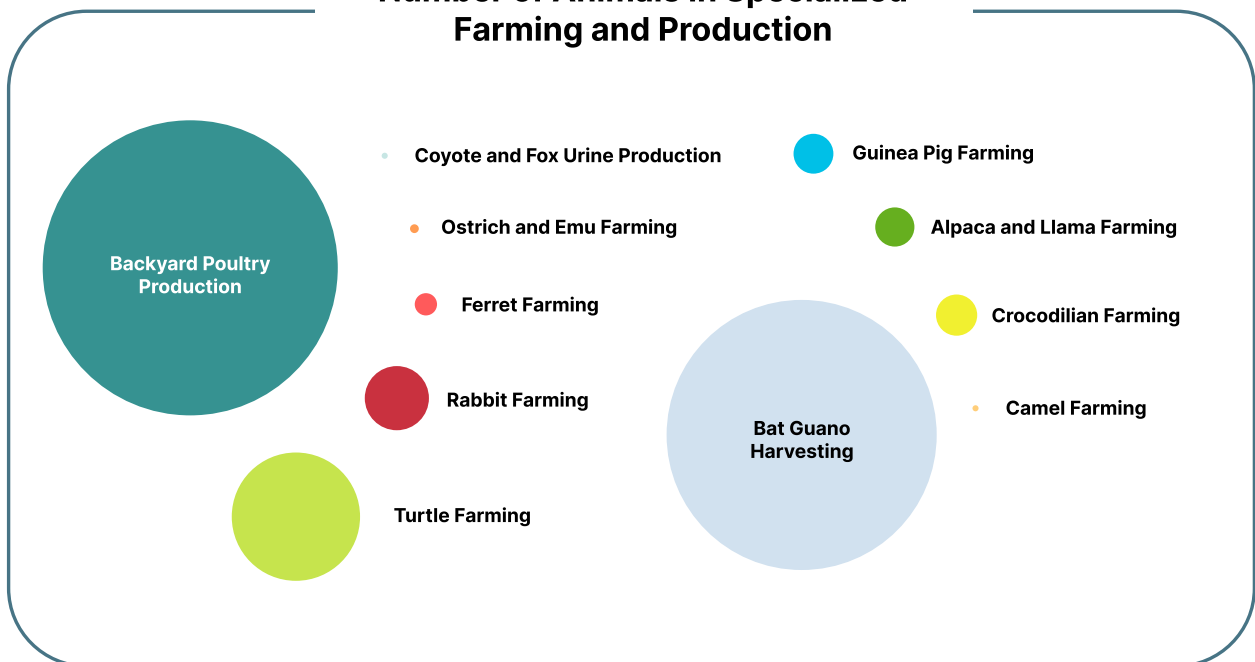
768. Claudio D. Miranda, Felix A. Godoy, and Matthew R. Lee, "Current Status of the Use of Antibiotics and the Antimicrobial Resistance in the Chilean Salmon Farms," *Frontiers in Microbiology* 9 (June 18, 2018): 1284, <https://doi.org/10.3389/fmicb.2018.01284>.



Specialized Farming and Production

A number of small-scale animal farming industries operate throughout the United States raising wild or domestic animals from a spectrum of different species. The list of specialized farming markets examined below is not exhaustive, but rather it is intended to provide a sample of how such systems of production operate. Producers range from backyard breeders and hobbyists to more established commercial operators. Some enterprises included in this section raise animals predominantly for meat, while others generate a particular product such as skins, wool, fur, milk, guano, or urine. Although the scale of these operations can appear marginal in comparison to others examined in this report, even small operations can carry significant public health risks, and the trajectory of a disease may be the same whether spillover occurs at a CAFO or a camel farm.

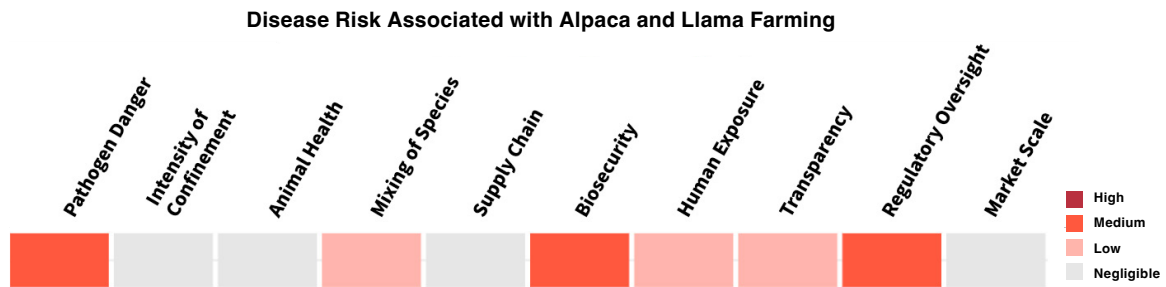
Number of Animals in Specialized Farming and Production



- Backyard Poultry Production, 18.4 million animals
- Bat Guano Harvesting, 15 million animals
- Turtle Farming, 3.4 million animals
- Rabbit Farming, 853,000 animals
- Crocodilian Farming, 350,000 animals
- Guinea Pig Farming, 341,000 animals
- Alpaca and Llama Farming, 300,000 animals
- Ferret Farming, 100,000 animals
- Ostrich and Emu Farming, 16,000 animals
- Camel Farming, 3,000 animals
- Coyote and Fox Urine Production, 3,000 animals

15. Alpaca and Llama Farming

Alpacas and llamas are two species of Camelidae kept primarily for wool production, though some are also kept as pets or livestock guardians. They are raised in outdoor pens, usually with a small shelter—a barn or three-sided lean-to.⁷⁶⁹ Animals are shorn at least once a year. There are over 260,000 alpacas across the United States with the largest number in Ohio, Washington, Oregon, New York, Colorado, and California.⁷⁷⁰ In the last Census of Agriculture report of 2017 (published every five years), there were fewer than 40,000 llamas in the United States, down from almost 145,000 llamas in 2002.⁷⁷¹



Risk of disease spread from alpacas and llamas is greatest at fairs, exhibitions, auctions, and other trade shows.⁷⁷² In the United Kingdom, tuberculosis, cryptosporidiosis, and sarcoptic mange are known diseases to have been transmitted from camelids to humans.⁷⁷³ However, there have not been widespread reports of these diseases on U.S. farms. Alpacas and llamas also can carry viruses such as rotavirus, foot and mouth disease, West Nile virus, and bacteria such as *Streptococcus zooepidemicus*, *Salmonella*, *Leptospira*, and *Streptococcus equi* (commonly known as “alpaca fever”).⁷⁷⁴

Perhaps of greater concern, in 2012, alpacas in Saudi Arabia were shown to be carriers of MERS-CoV (the pathogen that causes Middle East Respiratory Syndrome), though the virus is primarily found in camels. MERS-CoV is a coronavirus that is 35% fatal in humans and highly contagious.⁷⁷⁵ Although, to date, MERS-CoV has not been found in alpacas outside the Arabian Peninsula, there is concern that alpacas and other camelids could provide a foothold for the virus if it were introduced to North America. While current case reports of alpaca and llama-transmitted diseases are relatively rare, owners usually do have close contact with these animals, whether they are bred for wool or kept as pets. Alpaca and llamas are often treated as livestock and only lightly regulated. Importing camelids into

769. Andrew Amelinckx, “The Definitive Guide to Raising Alpacas,” *Modern Farmer*, September 22, 2015, <https://modernfarmer.com/2015/09/raising-alpacas/>.

770. “Alpacas Registered In The United States,” *Alpaca Owners Association*, accessed May 31, 2023, <https://www.alpacainfo.com/about/statistics/alpacas-us>.

771. The decline is mostly attributed to fading demand and novelty, coupled with reduced expendable income starting in 2007 and 2008 to feed this speculative industry. Phil McCausland, “Agriculture Census Finds That Llamas are Disappearing. What happened?” *NBCNews*, April 14, 2019, <https://www.nbcnews.com/news/us-news/llamas-disappearing-across-united-states-n994181>.

772. Juan M. Corpa, Francisco Carvallo, Mark L. Anderson, Akinyi C. Nyaoke, et al., “*Streptococcus equi* Subspecies *zooepidemicus* Septicemia in Alpacas: Three Cases and Review of the Literature,” *Journal of Veterinary Diagnostic Investigation* 30, No. 4 (July 2018): 598-602, <https://doi.org/10.1177/1040638718772071>.

773. K. Halsby, F. Twomey, C. Featherstone, A. Foster, et al., “Zoonotic Diseases in South American Camelids in England and Wales,” *Epidemiology and Infection* 145, no. 5 (April 2017): 1037-1043, <https://doi.org/10.1017/S0950268816003101>.

774. Juan M. Corpa, Francisco Carvallo, Mark L. Anderson, Akinyi C. Nyaoke, et al., “*Streptococcus equi* Subspecies *zooepidemicus* Septicemia in Alpacas: Three Cases and Review of the Literature,” *Journal of Veterinary Diagnostic Investigation* 30, No. 4 (July 2018): 598-602, <https://doi.org/10.1177/1040638718772071>.

775. “Middle East respiratory syndrome coronavirus (MERS-CoV),” *World Health Organization*, accessed May 31, 2023, https://www.who.int/health-topics/middle-east-respiratory-syndrome-coronavirus-mers#tab=tab_1.

the United States requires a USDA import permit.⁷⁷⁶ Some states also require a certificate of veterinary health inspection prior to moving animals into the state.⁷⁷⁷

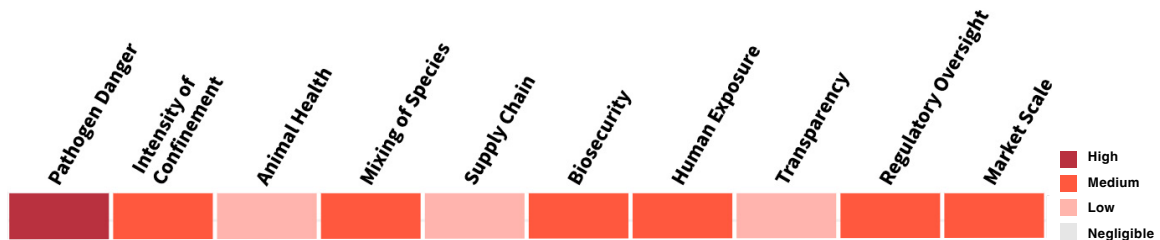
16. Backyard Poultry Production

Small-scale bird breeding, also often known as “backyard bird keeping,” is growing in popularity especially in urban and suburban areas in the United States. Roughly 13 million American households (1 in 10) raise backyard poultry, and 93% of major U.S. cities allow for urban poultry raising in some capacity.^{778 779 780} Birds are housed in a residential setting, some in the backyard of a home in a purpose-built bird coop consisting of a contained area, nesting boxes, and perches, while others are left to roam the premises freely and roost in trees. In some cases, birds have regular access to human living areas. A vast range of bird species are raised as backyard poultry, including chickens, ducks, geese, peafowl (peacocks), guinea fowl, pigeons, and turkeys. These birds are raised primarily for consumption of eggs and meat, although they may also be used as pets, as showbirds, or as sources of fertilizer or feathers.⁷⁸¹ Husbandry conditions vary greatly among breeders. Some backyard poultry owners operate intensively managed and highly elaborate systems for breeding and raising birds, keeping detailed records of their genetics and production. Others leave the birds, more or less, to fend for themselves. Only 3% of backyard flocks receive veterinary care, with larger operations being the most likely to employ veterinary assistance.⁷⁸²

Roughly 13 million American households (1 in 10) raise backyard poultry, and 93% of major U.S. cities allow for urban poultry raising in some capacity.



Disease Risk Associated with Backyard Poultry Production



776. “USDA, APHIS, Veterinary Services Strategy and Policy Protocol for the Importation of Farmed Camelids from Australia,” *USDA APHIS and Veterinary Services*, last modified May 2020, https://www.aphis.usda.gov/import_export/animals/downloads/aus-camelid.pdf.

777. See, for example, Wash. Admin. Code § 16-54-105.

778. Popularity surged during the pandemic. Some enterprises also began rental chicken operations. Caroline Dohack, “People Are Losing Their Clucking Minds Over Backyard Chickens,” *The Hustle*, May 16, 2020, <https://thehustle.co/how-much-does-it-cost-to-raise-chickens-coronavirus/>.

779. “Urban Chicken Ownership in Four U.S. Cities,” *United States Department of Agriculture Animal and Plant Health Inspection Service Veterinary Services National Animal Health Monitoring System*, April 2013, https://www.aphis.usda.gov/animal_health/nahms/poultry/downloads/poultry10/Poultry10_dr_Urban_Chicken_Four_1.pdf.

780. Molly R. Tobin, Jesse L. Goldshear, Lance B. Price, et al., “A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States,” *Public Health Reports* 130, No. 4 (July 2015): 380-391, <https://doi.org/10.1177/003335491513000417>.

781. C. Elkhoraibi, R.A. Blatchford, M.E. Pitesky, J.A. Mench, “Backyard Chickens in the United States: A Survey of Flock Owners,” *Poultry Science* 93, No. 11 (November 2014): 2920-2931, <https://doi.org/10.3382/ps.2014-04154>.

782. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

Birds are sourced from feed stores, hatcheries, auctions, swap meets, breeders, friends or relatives, and online sales, where chicks cost only about \$4 each and can be shipped via U.S. mail.⁷⁸³ The animals are transported in boxes, cages, and paper bags before being introduced to their new flocks. There is a large amount of turnover within the backyard poultry industry—36% of operators add new birds each year, while 18% sell or give away animals.⁷⁸⁶ The movement of animals within the industry and from various suppliers creates opportunities for pathogens to spread and access new healthy flocks. One important node in the supply chain are animal feed stores, which serve as a central hub of the backyard poultry industry, providing both supplies and information for customers on questions about husbandry. However, these businesses can also play an important role in disease transmission as they often carry live animals for sale and, potentially, pathogens brought by customers and suppliers from dozens of different locations.^{787 788} Those who raise backyard poultry often sell excess eggs, advertising through word-of-mouth, yard signs, and farmers markets. When birds die, they may be disposed of in household trash, composted, buried, or burned.⁷⁸⁹ The disposal process for manure and dead animals can pose additional zoonotic risks.

Unlike industrial poultry producers, backyard bird operations impose few if any biosecurity measures. Half or more of the birds have contact with wildlife—including waterfowl, the natural reservoirs for avian influenza.⁷⁹⁰ In addition, many owners raise multiple species of birds or other animals. Sixteen percent of operators also raise pigs, for example, a species that can serve as a mixing vessel for influenza viruses and may transmit them to humans.^{791 792} Sanitation practices are often overlooked in this more casual setting, making dangerous interactions between humans, wildlife, and captive birds all the more likely.⁷⁹³

Part of the disease risk posed by small-scale bird production is derived from the human dimension of these practices. Backyard breeders, more so than commercial breeders, have limited knowledge of disease risks and may be less likely to employ protective measures as a result. Many do not take basic precautions such as wearing gloves or washing hands after handling the animals.⁷⁹⁴

783. Hundreds of thousands of chicks are shipped through the U.S. Postal Service, though not all of the animals survive the journey. In addition, many are shipped in the spring, particularly around Easter, a time when avian influenza poses higher risks. “Avian Influenza,” *World Organisation for Animal Health*, accessed May 31, 2023, <https://www.oie.int/en/disease/avian-influenza>.

784. Scott Thistle, “Chicks shipped by mail are arriving dead, costing Maine farmers thousands of dollars,” *Portland Press Herald*, August 19, 2020, <https://www.pressherald.com/2020/08/19/dead-chick-deliveries-costing-maine-farmers-thousands-of-dollars/>.

785. The hatchery industry is highly consolidated with only twenty companies supplying national demand, selling straight to consumers as well as through feed stores. Molly R. Tobina, Jesse L. Goldshearb, Lance B. Price, Jay P. Graham, et al., “A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States,” *Public Health Reports* 130 (July-August 2015): 380-391, <https://journals.sagepub.com/doi/pdf/10.1177/003335491513000417>.

786. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

787. Feed stores have been linked to large-scale salmonellosis outbreaks. Jennifer L. Sidge, Kimberly Signs, Sally Bidol, Kelly Jones, et al., “Notes from the Field: Live Poultry Shipment Box Sampling at Feed Stores as an Indicator for Human Salmonella Infections—Michigan, 2016-2018,” *MMWR Morb Mortal Wkly Rep* 68 (2019): 407-408, <http://dx.doi.org/10.15585/mmwr.mm6817a6>.

788. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

789. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

790. Chrislyn Wood Nicholson, Enzo Riccard Campagnolo, Sameh W. Boktor, and Christina L. Butler, “Zoonotic Disease Awareness Survey of Backyard Poultry and Swine Owners in Southcentral Pennsylvania,” *Zoonoses Public Health* 67, no. 3 (May 2021): 280-290, <https://doi.org/10.1111/zph.12686>.

791. Chrislyn Wood Nicholson, Enzo Riccard Campagnolo, Sameh W. Boktor, and Christina L. Butler, “Zoonotic Disease Awareness Survey of Backyard Poultry and Swine Owners in Southcentral Pennsylvania,” *Zoonoses Public Health* 67, no. 3 (May 2021): 280-290, <https://doi.org/10.1111/zph.12686>.

792. Martha I. Nelson and Michael Worobey, “Origins of the 1918 Pandemic: Revisiting the Swine “Mixing Vessel” Hypothesis,” *Am J Epidemiol.* 187, No. 12 (December 2018): 2498-2502.

793. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

794. Chrislyn Wood Nicholson, Enzo Riccard Campagnolo, Sameh W. Boktor, and Christina L. Butler, “Zoonotic Disease Awareness Survey of Backyard Poultry and Swine Owners in Southcentral Pennsylvania,” *Zoonoses Public Health* 67, No. 3 (May 2021): 280-290, <https://doi.org/10.1111/zph.12686>.

Backyard bird breeders, defined as any operation with fewer than 1,000 birds, are exempt from USDA slaughter inspection.



Fifty percent of owners surveyed were unaware that live birds may pose a disease risk.^{795 796} Unlike commercial production, some backyard chickens are treated as pets, allowing increased human-animal contact, particularly with children. Wide differences in facilities, husbandry practices, and owner cooperation may present additional challenges to responding to disease outbreaks.⁷⁹⁷ All of these conditions persist amidst a regulatory backdrop that does little to mitigate such risks.

Backyard bird breeders, defined as any operation with fewer than 1,000 birds, are exempt from USDA slaughter inspection.⁷⁹⁸ Twenty-seven states also exempt these operations and impose no additional legal requirements for slaughter. The remaining 23 states do impose additional requirements for slaughter of poultry for human consumption.⁷⁹⁹

At the local level, backyard poultry is allowed in all but 11 of the 150 largest U.S. cities.⁸⁰⁰ In those jurisdictions that regulate the industry, most do so only with respect to flock size and the location

of coops or noise levels. Roughly one-third require operators to receive a permit.⁸⁰¹ Less than 10% of cities impose policies to govern the disposal of dead birds, and only a handful regulate slaughter.⁸⁰² Local ordinances governing backyard poultry operators are difficult to enforce and often lack a public health objective, leading to significant gaps in safety, though flocks may carry a host of pathogens from *Salmonella*, *Campylobacter*, and *E. coli* to Newcastle Disease and avian influenza.^{803 804} In addition, backyard birds may provide an important conduit for viruses and potentially amplify risks to large commercial flocks.

The backyard poultry industry provides a common and well-worn route of *Salmonella* transmission. Chickens, ducks, geese, turkey, and other live poultry can carry *Salmonella* bacteria in their guts, as well as in their droppings and on their feathers, feet, and beaks.⁸⁰⁵ These germs then spread through the environment, contaminating coops, feed and water dishes, surrounding soil, and ultimately,

795. Processing of the birds and disposal of carcasses also increases these risks. These problems persist after the birds are processed. For example, 60% of individuals rinsing raw poultry for consumption leave bacteria in their sinks. "Washing Raw Poultry: Our Science, Your Choice," *USDA*, August 20, 2019, <https://www.usda.gov/media/press-releases/2019/08/20/washing-raw-poultry-our-science-your-choice>.

796. Molly R. Tobin, Jesse L. Goldshear, Lance B. Price, et al., "A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States," *Public Health Reports* 130, No. 4 (July 2015): 380-391, <https://doi.org/10.1177/003335491513000417>.

797. Larry Allen, "Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan," *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/poultry_ind_manual.pdf.

798. 21 U.S.C.A. § 464.

799. "States With and Without Inspection Programs," *USDA Food Safety and Inspection Service*, last updated October 4, 2022, <https://www.fsis.usda.gov/inspection/apply-grant-inspection/state-inspection-programs/states-and-without-inspection-programs>.

800. Molly R. Tobin, Jesse L. Goldshear, Lance B. Price, et al., "A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States," *Public Health Reports* 130, No. 4 (July 2015): 380-391, <https://doi.org/10.1177/003335491513000417>.

801. Molly R. Tobin, Jesse L. Goldshear, Lance B. Price, et al., "A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States," *Public Health Reports* 130, No. 4 (July 2015): 380-391, <https://doi.org/10.1177/003335491513000417>.

802. Molly R. Tobin, Jesse L. Goldshear, Lance B. Price, et al., "A Framework to Reduce Infectious Disease Risk from Urban Poultry in the United States," *Public Health Reports* 130, No. 4 (July 2015): 380-391, <https://doi.org/10.1177/003335491513000417>.

803. Joel Salatin, "Chicken Processing Regulations," *Community Chickens*, February 12, 2020, <https://www.communitychickens.com/chicken-regulations-zw02002ztill/>.

804. "Backyard Poultry: Diseases," *Centers for Disease Control and Prevention*, last updated April 5, 2023, <https://www.cdc.gov/healthypets/pets/farm-animals/backyard-poultry.html>.

805. In many cases, the infected birds appear healthy.

residential homes. In a 2013 outbreak, which infected 356 people across 39 states with a hospitalization rate of 26% percent, 95% of infected persons reported purchasing live poultry from agricultural feed stores.⁸⁰⁶ Roughly 60% of ill persons were children under 10 years of age.⁸⁰⁷ That same year another outbreak spread across 30 states and was ultimately traced back to a single hatchery that supplied 95% of infected persons with mail-order chicks.⁸⁰⁸ The scale and breadth of hatchery distribution systems allows pathogens to be disseminated widely across the United States. Salmonellosis outbreaks continue to occur on an annual basis and backyard poultry remain a persistent source of infection. In 2019 and 2020, the CDC reported that 2,856 people across all 50 states were infected as a result of contact with backyard birds.⁸⁰⁹ Roughly a third of infected patients were hospitalized and nearly a quarter of those infected were children under the age of five.⁸¹⁰

Backyard flocks have been linked to other disease outbreaks as well. Virulent Newcastle disease, caused by Newcastle disease virus, a paramyxovirus that, the USDA notes, “is so virulent that many birds and poultry die without showing any clinical signs,” decimated backyard flocks in 2003 and caused subsequent outbreaks in 2018–2020.⁸¹¹ Three million birds were culled to contain this outbreak, costing taxpayers \$161 million in indemnification payments with industry losses estimated at \$5 billion, as hundreds of backyard flocks were infected alongside commercial producers.⁸¹³ While Newcastle disease virus has thus far only caused rare and mild effects in humans, it may carry significant zoonotic potential.⁸¹⁴ Like Nipah virus and Hendra virus, Newcastle disease virus belongs to the family of paramyxoviruses which carry the highest cross-species transmission rates of all RNA viruses.⁸¹⁶

Backyard poultry have also been affected by the current avian influenza outbreak, which, at the time of this writing, has reached 507 backyard flocks along with 325 commercial suppliers, leaving a total of over 58.7 million poultry dead.⁸¹⁷ Birds may transmit the virus through direct contact or indirect contact with contaminated surfaces, fecal/oral transmission, and the aerial spread of droplets and dust.⁸¹⁸ While the CDC maintains that the current risk to humans is low, the H5N1 strain of avian flu that is circulating

806. “Multistate Outbreak of Human Salmonella Typhimurium Infections Linked to Live Poultry in Backyard Flocks (Final Update),” *Centers for Disease Control and Prevention*, last modified November 1, 2013, <https://www.cdc.gov/salmonella/typhimurium-live-poultry-04-13/index.html>.

807. “Multistate Outbreak of Human Salmonella Typhimurium Infections Linked to Live Poultry in Backyard Flocks (Final Update),” *Centers for Disease Control and Prevention*, last modified November 1, 2013, <https://www.cdc.gov/salmonella/typhimurium-live-poultry-04-13/index.html>.

808. “Multistate Outbreak of Human Salmonella Infections Linked to Live Poultry (Final Update),” *Centers for Disease Control and Prevention*, last modified November 8, 2013, <https://www.cdc.gov/salmonella/live-poultry-04-13/index.html>.

809. “US Outbreaks of Zoonotic Diseases Spread between Animals & People,” *Centers for Disease Control and Prevention*, last updated May 22, 2023, <https://www.cdc.gov/healthypets/outbreaks.html#live-poultry>.

810. “Outbreaks of Salmonella Infections Linked to Backyard Poultry,” *Centers for Disease Control and Prevention*, last updated November 10, 2022, <https://www.cdc.gov/salmonella/backyardpoultry-06-22/index.html>.

811. Some commercial flocks are vaccinated against Newcastle disease in ovo, leaving backyard poultry at higher risk of infection. Kiril M Dimitrov, Tonya L Taylor, Valerie C Marcano, and Dawn Williams-Coplin, “Novel Recombinant Newcastle Disease Virus-Based In Ovo Vaccines Bypass Maternal Immunity to Provide Full Protection from Early Virulent Challenge,” *Vaccines* 9, No. 10 (2021): 1189, <https://doi.org/10.3390/vaccines9101189>.

812. “Virulent Newcastle Disease (vND),” *USDA Animal and Plant Health Inspection Service*, last January 9, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/virulent-newcastle/vnd>.

813. “Newcastle Disease Response, The Red Book,” *USDA*, February 2014, https://www.aphis.usda.gov/animal_health/emergency_management/downloads/newcastle_response_plan.pdf.

814. Only one known human death caused by Newcastle disease has occurred in the United States. However, presentations of lethal disease in a range of other species including pigs and mink demonstrate the virus’s adaptability to a wide range of host species. Scott J. Goebel, Jill Taylor, Bradd C. Barr, Timothy E. Kiehn, et al., “Isolation of Avian Paramyxovirus 1 From a Patient With a Lethal Case of Pneumonia,” *Journal Of Virology* 81, No. 22 (November 15, 2007): <https://doi.org/10.1128/JVI.01406-07>.

815. Mazhar I. Khan, *Newcastle Disease* (Boca Raton: CRC Press, 1994).

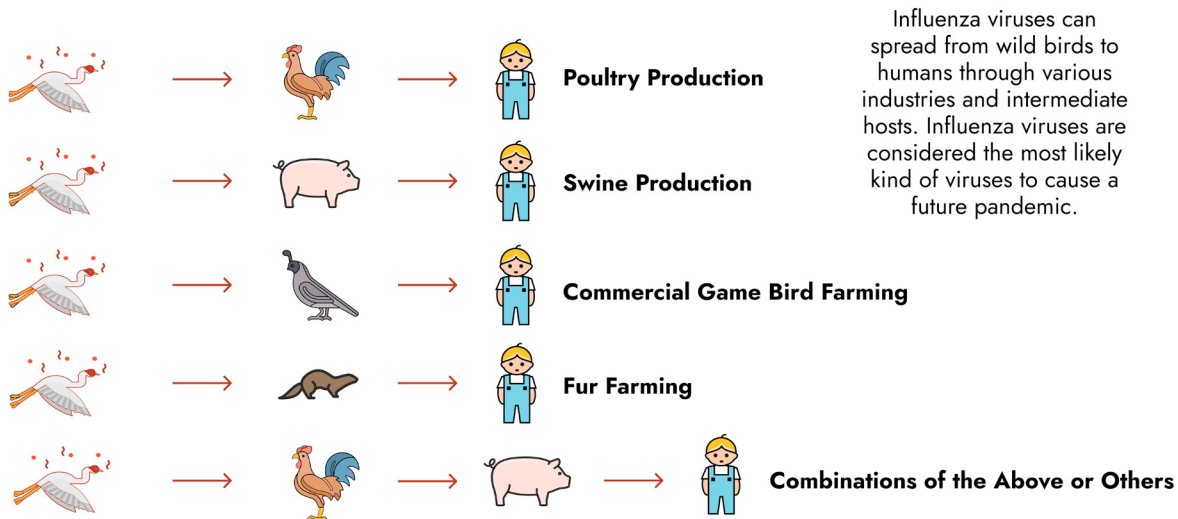
816. Aziz Ul-Rahman, Hafiz Ishaq, Muhammad Raza, and Muhammad Shabbir, “Zoonotic Potential of Newcastle Disease Virus: Old and Novel Perspectives Related to Public Health,” *Rev Med Virol* 32 (2022): <https://onlinelibrary.wiley.com/doi/epdf/10.1002/rmv.2246>.

817. “2022-2023 Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks,” *USDA Animal and Plant Inspection Service*, last modified January 18, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-commercial-backyard-flocks>.

818. “How Infected Backyard Poultry Could Spread Bird Flu to People,” *Centers for Disease Control and Prevention*, accessed May 31, 2023, <https://www.cdc.gov/flu/pdf/avianflu/avian-flu-transmission.pdf>.

widely throughout the Midwest has been shown to cross species barriers and infect humans in the past.⁸¹⁹ As one study notes, “Influenza A/H5N1, in particular, has repeatedly caused human infections associated with high mortality,” while another study calls it “an especially notorious strain... which has a mortality rate [in humans] of approximately 60%.”^{820 821} In these cases, infected persons are generally limited to poultry workers or bird owners who come into close contact with infected animals.

Pathways for Human Infection with Influenza Viruses



However, the real danger of outbreaks like this one derives from the risk that such a virus might mutate and gain the ability to spread person-to-person. Prior research has found that only a small number of changes to H5N1’s viral genome would be required to allow such airborne transmission between mammals.^{822 823} Given the ability of influenza to reassort and rapidly evolve, the longer an outbreak among animals persists, the greater the danger that a human pandemic influenza strain can emerge.⁸²⁴

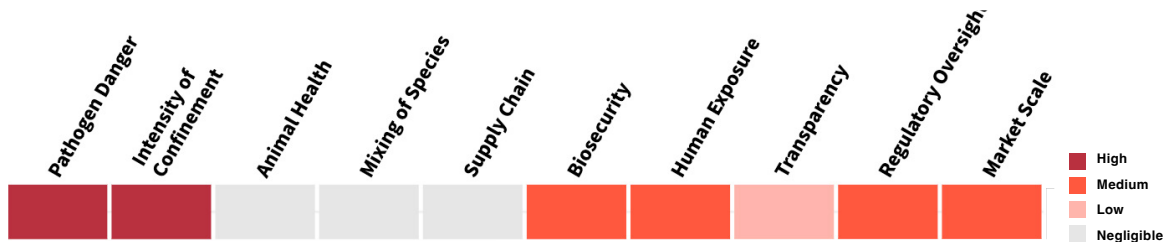
17. Bat Guano Harvesting

Guano is the excrement of seabirds and bats. It is used as a fertilizer due to its high content of nitrogen, phosphate, and potassium—key nutrients for plant growth. Bat guano has also been used in the United States for gun powder and other explosive materials.⁸²⁵ Guano is collected from caves

819. Berkeley Lovelace Jr., “Bird Flu Cases Surge in the U.S. What We Know So Far,” *NBCNews*, March 23, 2022, <https://www.nbcnews.com/health/health-news/bird-flu-outbreak-us-human-risk-remains-low-cdc-says-rcna20985>.
 820. Se Mi Kim, Young-Il Kim, Philippe Noriel Q. Pascua , and Young Ki Choi, “Avian Influenza A Viruses: Evolution and Zoonotic Infection,” *Semin Respir Crit Care Med* 37, No. 4 (2016): 501-511, doi: 10.1055/s-0036-1584953.
 821. Se Mi Kim, Young-Il Kim, Philippe Noriel Q. Pascua , and Young Ki Choi, “Avian Influenza A Viruses: Evolution and Zoonotic Infection,” *Semin Respir Crit Care Med* 37, No. 4 (2016): 501-511, doi: 10.1055/s-0036-1584953.
 822. Masaki Imai, Tokiko Watanabe, Masato Hatta, Subash C. Das, et al. “Experimental Adaptation of an Influenza H5 HA Confers Respiratory Droplet Transmission to a Reassortant H5 HA/H1N1 Virus in Ferrets,” *Nature* 486 (May 2012): 420-428, <https://doi.org/10.1038/nature10831>.
 823. Masaki Imai and Yoshihiro Kawaoka, “The Role of Receptor Binding Specificity in Interspecies Transmission of Influenza Viruses,” *Curr Opin Virol* 2, No. 2 (2012): 160-167, <https://doi.org/10.1016/j.coviro.2012.03.003>.
 824. Yong Poovorawan, Sunchai Pyungporn, Slinporn Prachayangprecha, and Jarika Makkoch, “Global Alert to Avian Influenza Virus Infection: From H5N1 to H7N9,” *Pathogens and Global Health* 107, No. 5 (July 2013): 217-223, <https://doi.org/10.1179/2047773213Y.0000000103>.
 825. Bats Conservation International, “From Guano Harvesting to Bat Warfare,” *Bats* 39, No. 1 (2020): <https://www.batcon.org/article/from-guano-harvesting-to-bat-warfare/>.

inhabited by free-roaming bats in a model more akin to beekeeping than traditional forms of farming that involve captive animals. Bracken Cave near San Antonio, Texas supports more than 15 million Mexican free-tailed bats and is the largest bat maternal nesting colony in the world.⁸²⁶ Recent measurements estimate the current depth of guano in Bracken Cave to be between 75 and 100 feet in the 117-foot-tall cave. Purveyors harvest up to 50 tons of guano annually from Bracken cave alone. Workers in the cave shovel guano into air compressor-filled sacks and in one day can pull out 200 bags, or roughly 8,800 pounds, of guano.⁸²⁷ Similar caves are found around the United States, including in Oklahoma, California, Tennessee, and Maryland.^{828 829 830}

Disease Risk Associated with Bat Guano Harvesting



Many bacterial, fungal, and viral pathogens have been identified in bat guano. Bats are believed to be a reservoir for many viruses, including SARS-related coronaviruses. There has been at least one reported instance in China of bat-human disease transmission during the process of guano harvesting, in which six men fell ill with a severe respiratory disease.⁸³¹ However, there have been no such reports in the United States. Bats are believed to be reservoir species for Nipah virus (NiV), Ebola virus (EBOV), Rabies virus, MERS coronavirus (MERS-CoV), as well as others and carry the fungus that causes histoplasmosis in humans.^{832 833 834 835 836} Of 105 outbreaks in the United States from 1938–2013 of histoplasmosis, bats or their droppings were present in



826. A maternal colony refers to a temporary colony consisting of pregnant females and their offspring. The colony usually stays together for the birthing, nursing, and weaning of their offspring.

827. Sara Keleher, "Guano: Bats' Gift to Gardeners," *Bat Conservation International*, *Bats* 14, No. 1, (March 1996): <https://www.batcon.org/article/guano-bats-gift-to-gardeners/>.

828. "Bats," *The Nature Conservancy*, July 16, 2020, <https://www.nature.org/en-us/get-involved/how-to-help/animals-we-protect/bats/>.

829. Six of the 47 bat species found in the United States are listed as endangered species under the Endangered Species Act. These include the Florida Bonneted Bat, Gray Bat, Indiana Bat, Ozark Big-Eared Bat, Virginia Big-Eared Bat, and the Mexican Long-Nosed Bat. "9 of the Coolest Bat Species in the United States," *US Dept of Interior Blog*, October 24, 2018, <https://www.doi.gov/blog/9-coolest-bat-species-united-states>.

830. Robert Currie, "Federally Listed Threatened and Endangered Bat Species of Importance to Caves and Mines," in *Cave Conservation and Restoration*, eds. Val Hildreth-Werker and Jim Werker, National Speleological Society, 2006.

831. Carolyn Kormann, "The Mysterious Case of the COVID-19 Lab-Leak Theory," *The New Yorker*, October 12, 2021, <https://www.newyorker.com/science/elements/the-mysterious-case-of-the-covid-19-lab-leak-theory>.

832. Raina K. Plowright, Daniel J. Becker, Daniel E. Crowley, Alex D. Washburne, et al., "Prioritizing Surveillance of Nipah Virus in India," *PLOS Neglected Tropical Diseases* 17, No. 2 (June 27, 2019): e0011126, <https://doi.org/10.1371/journal.pntd.0011126>.

833. Almudena Mari Saéz, Sabrina Weiss, Kathrin Nowak, Vincent Lapeyre, et al., "Investigating the Zoonotic Origin of the West African Ebola Epidemic," *EMBO Molecular Medicine* 7 (2015): 17-23, <https://doi.org/10.15252/emmm.201404792>.

834. Rene Edgar Condori-Condori, Daniel G. Streicker, Cesar Cabezas-Sanchez, and Andres Velasco-Villa, "Enzootic and Epizootic Rabies Associated with Vampire Bats, Peru," *Emerg Infect Dis.* 19, No. 9 (September 2013): 1463-1469, doi: 10.3201/eid1909.130083.

835. Hamzah A. Mohd, Jaffar A. Al-Tawfiq, and Ziad A. Memish, "Middle East Respiratory Syndrome Coronavirus (MERS-CoV) Origin and Animal Reservoir," *Virology Journal* 13, No. 87 (2016): <https://doi.org/10.1186/s12985-016-0544-0>.

836. Antoine A. Adenis, Christine Aznar, and Pierre Couppié, "Histoplasmosis in HIV-Infected Patients: A Review of New Developments and Remaining Gaps," *Current Tropical Medicine Reports* 1, No. 2 (2014): 119-128, <https://doi.org/10.1007/s40475-014-0017-8>.

23% of the outbreak settings.^{837 838} Bat guano can also contain bacterial pathogens including *Pasteurella*, *Salmonella*, *Shigella*, *Escherichia*, *Klebsiella*, *Proteus*, *Yersinia*, *Hafnia*, *Serratia*, *Staphylococcus*, and *Campylobacter*.⁸³⁹

Entering caves to harvest bat guano presents a serious risk of zoonotic transmission both through the guano itself and through close contact with the bats that produce it. Elsewhere in the world, even activities such as mining, whereby humans may enter bat habitat for other reasons, have given rise to deadly zoonotic outbreaks.⁸⁴⁰

⁸⁴¹ There are state and local guidelines as well as CDC guidelines for handling bats, but there are no known regulations in the United States governing bat guano farming.^{842 843 844 845}

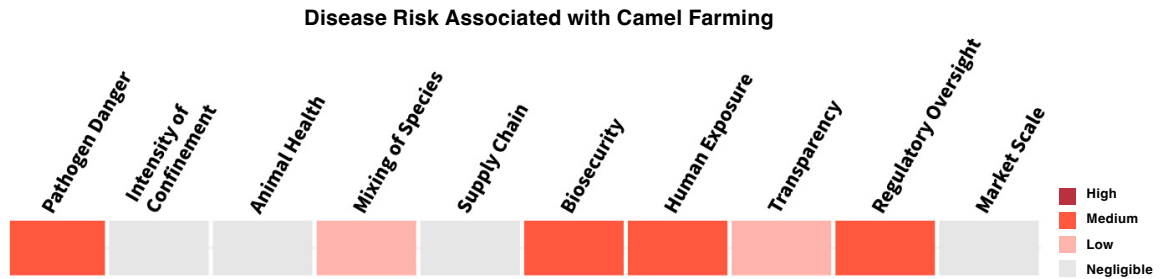
There are state and local guidelines as well as CDC guidelines for handling bats, but there are no known regulations in the United States governing bat guano farming.

18. Camel Farming



Camel farming in the United States is a small but growing market, especially among the Amish and Mennonite communities. There are approximately 3,000 farmed camels in the United States. Camel milk is marketed as an alternative milk source for those with allergies to cow's milk.⁸⁴⁶ The same FDA regulations that govern cows milk also apply to camel milk: the milk must be pasteurized or aseptically processed before being sold to consumers across state lines.⁸⁴⁷ Raw milk from both camels and cows can carry bacterial pathogens such as *Campylobacter*, *Brucella*, *E. coli*, *Listeria*, and *Salmonella*. Because of this zoonotic risk, the FDA does not allow the interstate sale of raw milk. However, many producers offer raw milk for sale locally, and currently, 31 states allow for the sale of raw milk, which in particular carries a greater risk of brucellosis than pasteurized milk. Studies have shown that states that legalize raw milk sales experienced greater numbers of disease outbreaks related to milk consumption.⁸⁴⁸

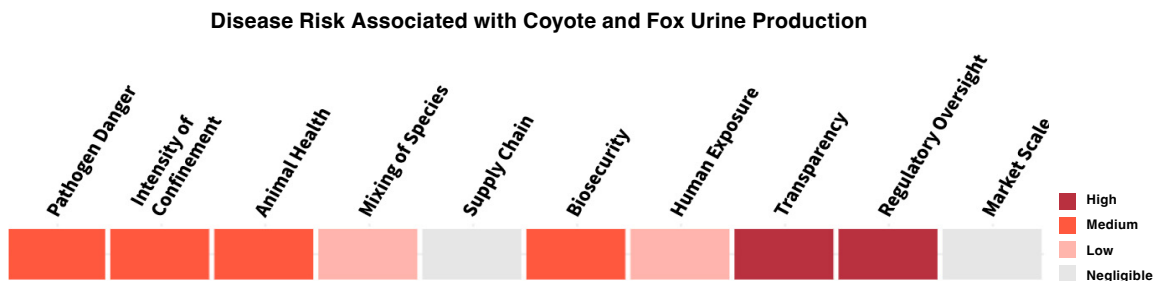
837. Kaitlin Benedict and Rajal K. Mody, "Epidemiology of Histoplasmosis Outbreaks, United States, 1938-2013," *Emerging Infectious Diseases* 22, No. 3 (March 2016): 370-378, <https://doi.org/10.3201/eid2203.151117>.
838. Antoine A. Adenis, Christine Aznar, and Pierre Couppié, "Histoplasmosis in HIV-Infected Patients: A Review of New Developments and Remaining Gaps," *Current Tropical Medicine Reports* 1, No. 2 (2014): 119-128, <https://doi.org/10.1007/s40475-014-0017-8>.
839. Ivica Dimkić, Djordje Fira, Tamara Janakiev, Jovana Kabić, et al., "The Microbiome of Bat Guano: For What is This Knowledge Important?" *Applied Microbiology and Biotechnology* 105 (January 2021): 1407-1419, <https://doi.org/10.1007/s00253-021-11143-y>.
840. Adrian Burton, "Marburg Miner Mystery," *The Lancet Infectious Diseases* 4, No. 2 (February 2004): 67, [https://doi.org/10.1016/S1473-3099\(04\)00917-X](https://doi.org/10.1016/S1473-3099(04)00917-X).
841. Daniel G. Bausch, Stuart T. Nichol, Jean-Jacques Muyembe-Tamfum et al, "Marburg Hemorrhagic Fever Associated with Multiple Genetic Lineages of Virus," *The New England Journal of Medicine* 355 (August 31, 2006): 909-919, <https://doi.org/10.1056/NEJMoa051465>.
842. A. Michael. Glassey and John F. Karlik, "Pests of Homes, Structures, People, and Pets: Bats," University of California Agriculture and Natural Resources, *UC ANR Publication* 74150, March 2021, <http://ipm.ucanr.edu/PMG/PESTNOTES/pn74150.html>.
843. "Bats," *Centers for Disease Control and Prevention*, last updated January 10, 2022, <https://www.cdc.gov/rabies/exposure/animals/bats.html>.
844. Some species of bats are federally protected as endangered or threatened species. Marina Somma, "Regulations on the Removal of Bats," *Sciencing*, last updated September 30, 2021, <https://sciencing.com/regulations-removal-bats-5818748.html>.
845. Human development in bat habitat can augment risk. For example, residential developments have been built as close as a half mile from the Bracken Cave in Texas, leading to increased human contact with bats and bat guano.
846. Boulder Daily Camera, "Longmont Farmer Hails Camels' Milk as a 'Super Food,'" *The Denver Post*, September 15, 2014, <https://www.denverpost.com/2014/09/15/longmont-farmer-hails-camels-milk-as-a-super-food/>.
847. "State Milk Laws," *National Conference of State Legislatures*, August 29, 2016, <https://www.ncsl.org/research/agriculture-and-rural-development/raw-milk-2012.aspx>.
848. Adam J. Langer, Tracy Ayers, Julian Grass, Michael Lynch, et al., "Nonpasteurized Dairy Products, Disease Outbreaks, and State Laws—United States, 1993–2006," *Emerging Infectious Diseases* 18, No. 3 (March 2012): 385-391, <https://doi.org/10.3201/eid1803.111370>.



Middle East respiratory syndrome (MERS), caused by MERS-CoV and initially identified in the Arabian Gulf in 2012, is the camel-borne virus of greatest concern.^{849 850} Although MERS-CoV has not been found in camels in the United States thus far, there is concern that camelids could become infected if MERS-CoV were introduced to the region.⁸⁵¹

19. Coyote and Fox Urine Production

Coyotes and foxes, as well as other animals, are farmed in the United States for their urine.⁸⁵² The urine, with its ammonia-like scent, is used both as a repellent by gardeners and those who wish to ward off small mammals and deer, but also as an attractant for hunters and trappers who use the urine as a lure to attract wild coyotes and foxes or cover their own scent.⁸⁵³ The urine is sold commercially, but there is very little information about, and virtually no monitoring of, coyote or fox urine farming. The market landscape is similarly murky. In 2006, a large 10-facility operation in Maine was believed to supply 90% of the coyote urine market in the United States.⁸⁵⁴ This is the only market data available and the facility owner did not respond to inquiries from the authors of this report.⁸⁵⁵



The sale of urine for use as a pesticide or as a mask or lure is regulated by the EPA.⁸⁵⁶ While these laws govern the processing of the end product, the amount of oversight regarding the urine

849. Byron Breedlove, "Veiled Dangers in an Idyllic Setting," *Emerging Infectious Diseases* 26, No. 2 (February 2020): 395-396, <https://doi.org/10.3201/eid2602.ac2602>.

850. One in three of those infected have died of the disease, which is a dangerous form of coronavirus. Adam J. Langer, Tracy Ayers, Julian Grass, Michael Lynch, et al., "Nonpasteurized Dairy Products, Disease Outbreaks, and State Laws—United States, 1993–2006," *Emerging Infectious Diseases* 18, No. 3 (March 2012): 385-391, <https://doi.org/10.3201/eid1803.111370>.

851. Chantal B.E.M. Reusken, Chrispijn Schilp, V. Stalin Raj, Erwin De Bruin, et al., "MERS-CoV Infection of Alpaca in a Region Where MERS-CoV is Endemic," *Emerging Infectious Diseases* 22, No. 6 (June 2016): 1129-1131, <https://doi.org/10.3201/eid2206.152113>.

852. A wide variety of other urine types are sold commercially in the United States, including deer, mink, raccoon, opossum, bobcat, wolf, and others.

853. David M. Ferreroa, Jamie K. Lemona, Daniela Fluegge, Stan L. Pashkovski, et al., "Detection and Avoidance of a Carnivore Odor by Prey," *PNAS Biological Sciences* 108, No. 27 (June 20, 2011): 11235-11240, <https://doi.org/10.1073/pnas.1103317108>.

854. Constance Casey, "The Deer Wars: Does Coyote Urine Scare Away the Gardener's 150-Pound Scourge?" *Slate*, January 24, 2006, <https://slate.com/news-and-politics/2006/01/does-coyote-urine-scare-away-deer.html>.

855. The operation is licensed to do business in the state of Maine.

856. The EPA regulates end-use products containing coyote urine or fox urine as their active ingredients. "Predator Urines: Coyote Urine, Fox Urine," *U.S. Environmental Protection Agency*, Office of Pesticide Programs Biopesticides and Pollution Prevention Division, accessed May 31, 2023, https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/decision_G-4640_1-Dec-04.pdf.

production process is not clear and little is known about the associated risks. One of the leading sellers in the United States of coyote urine pellets suggests that the animals are not touched during the collection process. Instead, animals are kept in enclosed cages with permeable or slanted floors such that when they eliminate urine, the waste is collected below into drains.⁸⁵⁷ Presumably, such a process would result in the collection of other fluids and solids as well. There is concern that both keeping these animals in close confinement and handling runoff from their enclosures could present risk of pathogen transmission. More information and transparency is needed in order to better understand these possible risks and how to best mitigate them.

20. Crocodylian Farming

Alligators, caimans, gharials, and crocodiles are known collectively as “crocodylians.”⁸⁵⁸ While their meat is sometimes sold as a by-product, these animals are raised primarily for high-quality leather made from their belly skin, which is sold for use by the fashion industry within the United States and around the world. For this reason, care is taken during rearing to minimize damage to the belly skin from the surfaces of their enclosures. The density at which crocodiles are maintained is reduced as they grow larger, which helps to reduce interactions between individuals (in order to protect their skin from damage by others) and to promote growth.⁸⁵⁹ The American alligator is the crocodylian species most commonly raised for commercial purposes in the United States. As of 2014, there were approximately 37 alligator production facilities spread across four states: Louisiana, Florida, Georgia, and Texas.^{860 861} These farms in aggregate produced slightly more than 350,000 hides, with a total value of hides and meat exceeding \$85 million. Louisiana and Florida farms account for more than 98 percent of the production.⁸⁶² In addition to skin and meat products, some alligators are used in alligator wrestling events, which are held in at least 13 venues around the state of Florida.⁸⁶³ These wrestling events are usually promoted on social media and serve as a tourist attraction.⁸⁶⁴



857. “Frequently Asked Questions,” *Shake-Away Organic Pest Repellent*, accessed May 31, 2023, <https://www.shake-away.com/product-faq>.

858. Mark O’Shea, *Smithsonian Handbooks: Reptiles and Amphibians* (London: Penguin Random House, 2002).

859. “Farming and the Crocodile Industry,” *Crocodyle Specialist Group*, accessed May 31, 2023, <http://www.iucncsg.org/pages/Farming-and-the-Crocodyle-Industry.html>.

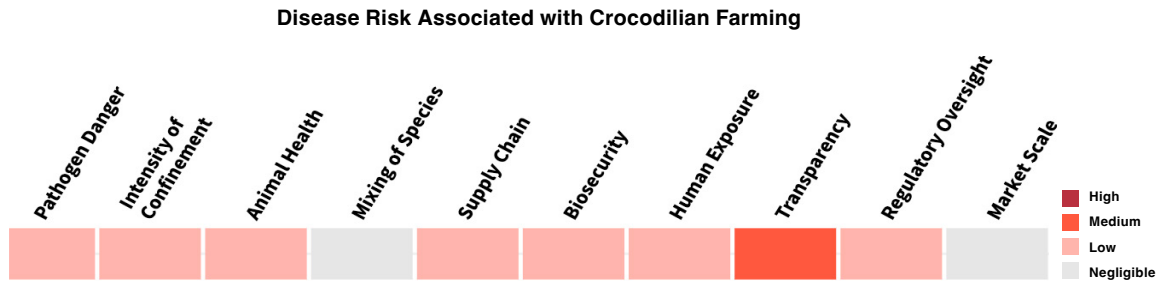
860. Mark Shirley and Ruth Elsey, “American Alligator Production: An Introduction,” *Southern Regional Aquaculture Center*, SRAC Publication No. 230, September 2015, <https://fisheries.tamu.edu/files/2018/12/SRAC-0230.pdf>.

861. Douglas Hamilton, “Waste Management for Alligator Farming and Ranching,” *Oklahoma Cooperative Extension Service*, Oklahoma State University, BAE-1771, February 2020, <https://extension.okstate.edu/fact-sheets/print-publications/bae/waste-management-for-alligator-farming-and-ranching-bae-1771.pdf>.

862. Mark Shirley and Ruth Elsey, “American Alligator Production: An Introduction,” *Southern Regional Aquaculture Center*, SRAC Publication No. 230, September 2015, <https://fisheries.tamu.edu/files/2018/12/SRAC-0230.pdf>.

863. Casey Riordan, Jennifer Jacquet, and Becca Franks, “Investigating the Welfare and Conservation Implications of Alligator Wrestling for American Alligators (*Alligator mississippiensis*),” *PLoS ONE* 15, No. 11 (November 13, 2020): <https://doi.org/10.1371/journal.pone.0242106>.

864. Casey Riordan, Jennifer Jacquet, and Becca Franks, “Investigating the Welfare and Conservation Implications of Alligator Wrestling for American Alligators (*Alligator mississippiensis*),” *PLoS ONE* 15, No. 11 (November 13, 2020): <https://doi.org/10.1371/journal.pone.0242106>.



Alligator farming is regulated at both the federal and state level. FWS continues to protect the American alligator under the Endangered Species Act (ESA) classification as threatened due to similarity of appearance to other protected species such as crocodiles and caimans.⁸⁶⁵ Individual state agencies regulate both wild harvest and farm production activities through license requirements.⁸⁶⁶ Louisiana has housing requirements for the alligators (i.e., secured premises, clean water, controlled temperature) as well as slaughter requirements (performed only in a manner that causes a rapid loss of consciousness and death). In addition, all alligator farms are subject to inspection by the Louisiana Department of Wildlife and Fisheries (LDWF). The LDWF also tracks the size and number of alligators slaughtered.^{867 868} Florida has similar requirements and oversight departments.⁸⁶⁹

Crocodylians can become infected with zoonotic viruses from insects, such as West Nile virus, and can transmit these viruses via scratches or wounds, blood, fecal or oral transmission, and possibly through contact with contaminated water.^{870 871 872} In the last 20 years, there have been outbreaks of infection with West Nile virus in both human populations and in farmed American alligators in Georgia, Louisiana, and Florida, with documented cases of alligator-to-human transmission.^{873 874} Research suggests that alligators may serve as important carriers and amplifying hosts of the West Nile virus.⁸⁷⁵

Microbiology research on human wounds caused by alligator bites is limited.^{876 877 878} However,

865. "Alligator mississippiensis," U.S. Fish and Wildlife Service, accessed June 3, 2022, <https://www.fws.gov/species/american-alligator-alligator-mississippiensis>.

866. Mark Shirley and Ruth Elsey, "American Alligator Production: An Introduction," *Southern Regional Aquaculture Center*, SRAC Publication No. 230, September 2015, <https://fisheries.tamu.edu/files/2018/12/SRAC-0230.pdf>.

867. "Louisiana Alligator Regulations," *State of Louisiana Wildlife and Fisheries Commission*, June 2017, https://www.louisianaalligators.com/uploads/1/0/4/8/104800207/2017_alligator_regulations_tableofcontents.pdf.

868. "Alligator Management," *Louisiana Wildlife and Fisheries*, accessed May 31, 2023, <https://www.wlf.louisiana.gov/page/alligator-management>.

869. "Alligator Regulations and Associated Statutes, 2021-2022," *Florida Fish and Wildlife Conservation Commission*, accessed May 31, 2023, <https://myfwc.com/media/1744/alligator-rules-booklet.pdf>.

870. Javier Nevarez, "Crocodylians," *Manual of Exotic Pet Practice* (2009): 112–135, doi: 10.1016/B978-141600119-5.50009-3. Epub 2009 Nov. 30. PMID: PMC7152205.

871. Audrey Rachlin, Mariana Kleinecke, Mirjam Kaestli, Mark Mayo, et al., "A Cluster of Melioidosis Infections in Hatchling Saltwater Crocodiles (*Crocodylus porosus*) Resolved Using Genome-Wide Comparison of a Common North Australian Strain of *Burkholderia pseudomallei*," *Microbial Genomics* 5, No. 8 (August 2019): doi: 10.1099/mgen.0.000288.

872. Gervais Habarugira, Jasmin Moran, Agathe M.G. Colmant, Steven S. Davis, et al., "Mosquito-Independent Transmission of West Nile Virus in Farmed Saltwater Crocodiles (*Crocodylus porosus*)," *Viruses* 12, No. 2 (February 2020): 198.

873. Rachel M. McNew, Ruth M. Elsey, Thomas R. Rainwater, Eric J. Marsland, Steven M. Presley, "Survey for West Nile Virus Infection in Free-ranging American Alligators in Louisiana," *Southeastern Naturalist* 6, no. 4 (2007): 737-742, [https://doi.org/10.1656/1528-7092\(2007\)6\[737:SFWNVI\]2.0.CO;2](https://doi.org/10.1656/1528-7092(2007)6[737:SFWNVI]2.0.CO;2).

874. Ellen Ariel, "Viruses in Reptiles," *Veterinary Research* 42, no. 100 (2011): <https://doi.org/10.1186/1297-9716-42-100>.

875. Kaci Klenk, Jamie Snow, Katrina Morgan, Richard A. Bowen, et al., "Alligators as West Nile Virus Amplifiers," *Emerging Infectious Diseases* 10, No. 12 (December 2004): 2150-2155, <https://doi.org/10.3201/eid1012.040264>.

876. Rickey Langley, "Alligator Attacks on Humans in the United States," *Wilderness Environmental Medicine* 16, No. 3 (September 2005): 119-124, [https://doi.org/10.1580/1080-6032\(2005\)16\[119:AAOHIT\]2.0.CO;2](https://doi.org/10.1580/1080-6032(2005)16[119:AAOHIT]2.0.CO;2).

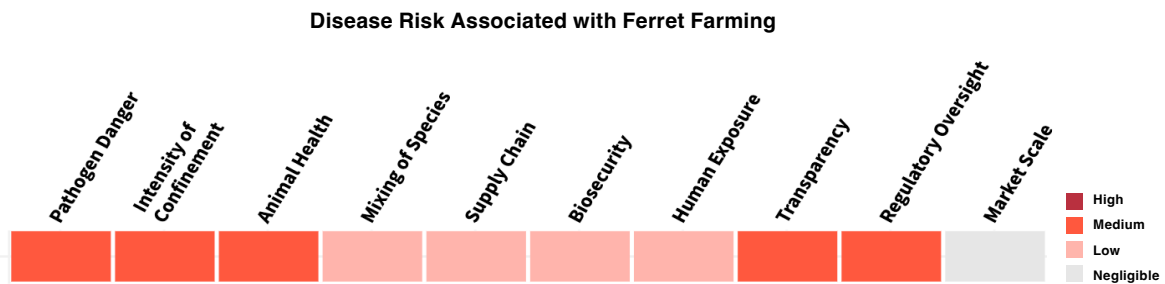
877. Rickey Langley, "Alligator Attacks on Humans in the United States," *Wilderness Environmental Medicine* 16, No. 3 (September 2005): 119-124, [https://doi.org/10.1580/1080-6032\(2005\)16\[119:AAOHIT\]2.0.CO;2](https://doi.org/10.1580/1080-6032(2005)16[119:AAOHIT]2.0.CO;2).

878. Alligators are known to cause serious or fatal injuries to humans, especially when stressed, for example, due to poor living conditions or forced interaction with humans. Casey Riordan, Jennifer Jacquet, and Becca Franks, "Investigating the Welfare and Conservation Implications of Alligator Wrestling for American Alligators (*Alligator mississippiensis*)," *PLoS ONE* 15, No. 11 (November 13, 2020): <https://doi.org/10.1371/journal.pone.0242106>.

zoonotic bacteria such as the *Citrobacter* and *Salmonella* have been found in wounds.⁸⁷⁹ Crocodylians can also carry herpesvirus and poxvirus, as well as a range of bacterial agents, making hygiene practices particularly important for handlers.⁸⁸⁰ 881 Though crocodylians can and have transmitted pathogens to other species including humans, the risk of such transmission is relatively low and the industry, on the whole, is better regulated than most other forms of wildlife farming.

21. Ferret Farming

Ferrets are popular pets, with over 500,000 ferrets kept by owners in the United States.⁸⁸² Ferrets are small carnivores, which can sometimes act aggressively toward humans and may pose a threat to wildlife if not properly contained.⁸⁸³ In part because of these concerns, states such as California and Hawaii as well as cities including New York City and Washington, D.C. have banned ownership of ferrets.⁸⁸⁴ There are relatively few U.S. ferret breeders and most are small operations.⁸⁸⁵ There is also a set of larger commercial ferret wholesalers, led by Marshall Farms in New York, which sells to pet dealers throughout the United States and abroad.⁸⁸⁶



Ferrets can transmit zoonoses to humans and present a higher risk of disease relative to other common pets. In a laboratory setting, ferrets have become infected with both SARS-CoV-1 and SARS-CoV-2 and were found to be contagious to other animals, and because of similarities between the manner of respiratory disease development in ferrets and humans, it is presumed that they could similarly transmit such viruses to

Ferrets can transmit zoonoses to humans and present a higher risk of disease relative to other common pets.

879. Ellie J. C. Goldstein and Fredrick M. Abrahamian, "Animal Bites and Zoonoses: From A to Z: Alligators to Zebras." In: Sing A. (eds) *Zoonoses - Infections Affecting Humans and Animals* (Dordrecht: Springer, 2015), https://www.researchgate.net/publication/368417161_Animal_Bites_and_Zoonoses_From_A_to_Z_-_Alligators_to_Zebras.

880. Matthew J.Lottae, Rhiannon L.Moore, Natalie L.Milic, Michelle Power, et al., "Dermatological Conditions of Farmed Crocodylians: A Review of Pathogenic Agents and Their Proposed Impact on Skin Quality," *Veterinary Microbiology* 225 (November 2018): 89-100, <https://doi.org/10.1016/j.vetmic.2018.09.022>.

881. Pamela D. Govett, Craig A. Harms, April J. Johnson, Kenneth S. Latimer, et al., "Lymphoid Follicular Cloacal Inflammation Associated with a Novel Herpesvirus in Juvenile Alligators (*Alligator mississippiensis*)," *J Vet Diagn Invest* 17 (September 2005): 474-479, doi: 10.1177/104063870501700513.

882. "U.S. Pet Ownership Statistics," *American Veterinary Medical Association*, accessed May 31, 2023, <https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics>.

883. "Are Ferrets Illegal in the US?" *Ethos Veterinary Health*, December 16, 2020, <https://www.ethosvet.com/blog-post/are-ferrets-illegal-in-the-us/>.

884. The ban in California dates back to 1993 and was originally enacted due to the perceived aggressive nature of the animals as well as their potential to spread rabies. Anja Delic, Anja, "Why Are Ferrets Still Illegal In California In Year 2021?" *Friendly Ferret*, October 18, 2021, <https://friendlyferret.com/why-are-ferrets-illegal-in-california/>.

885. David Zach, "Ferret Breeders Near You With Ferrets For Sale (2022)," *Beyond The Treat*, accessed May 31, 2023, <https://beyondthetreat.com/ferret-breeders/>.

886. "Baby Ferrets," *Marshall Farms*, accessed May 31, 2023, <https://www.marshallferrets.com/baby-ferrets/>.

humans.^{887 888} *Pseudomonas luteola*, a bacterial infection causing respiratory disease and abscess formation, Hepatitis E, and rabies are other examples of zoonotic diseases that have been reported in ferrets in the United States.⁸⁸⁹ Ferrets can also carry other bacteria such as *Campylobacter* and *Salmonella* and parasites such as *Giardia* and *Cryptosporidia* in their intestinal tract and spread them to people who clean their cages and litter boxes.^{890 891 892} Ferrets are regulated entirely at the state level with wide variation among states. Some states impose no regulation at all, while roughly fifteen other states require rabies vaccination and four require permits for possession or sale.⁸⁹³



22. Guinea Pig Farming

Guinea pigs are farmed in the United States to supply the pet trade, research laboratories, and exotic meat markets.⁸⁹⁴ The animals are regulated differently depending on their use designation. Guinea pig meat is more commonly consumed in South America where it is known as “cuy” or “cavy.” However, it is also available in the United States in both grocery stores and restaurants, particularly those in Latin American communities in California, Florida, New Jersey, and New York. Guinea pigs can be quite profitable as a farmed animal, as they require much less room than traditional livestock and they reproduce extremely quickly. They are typically kept in a hutch or pen with wire siding and straw bedding. Animals are housed together with many others and enclosures are usually placed next to one another. Producers may raise 1,000 or more animals at a time. Because of the close confinement and sheer number of animals housed together, these operations have the potential to spread pathogens quickly among animals. USDA records indicate that these facilities do not always provide adequate welfare, with some facilities lacking sanitation while others were cleaned only once a year.⁸⁹⁵ Sick or dead animals may be stored alongside live ones and, given the sheer number of animals kept at larger production operations, go unnoticed.⁸⁹⁶

887. Alison E. Stout, Qinghua Guo, Jean K. Millet, Ricardo de Matos, et al., “Coronaviruses Associated with the Superfamily Musteloidea,” *mBio* 12, No. 1 (January 19, 2021): <https://doi.org/10.1128/mBio.02873-20>.

888. European Food Safety Authority and European Centre for Disease Prevention and Control, Anette Boklund, Christian Gortázar, Paolo Pasquali, et al., “Monitoring of SARS-CoV-2 Infection in Mustelids,” *EFSA Journal* 19, No. 3 (March 2021): <https://doi.org/10.2903/j.efsa.2021.6459>.

889. Nicole Wyre, “Emerging Zoonotic Diseases in Ferrets,” *Vet Clin North Am Exot Anim Pract* 23, No. 2 (May 2020): 299-308, <https://doi.org/10.1016/j.cvex.2020.01.012>.

890. “Ferrets,” *Centers for Disease Control and Prevention*, last modified March 8, 2022, <https://www.cdc.gov/healthypets/pets/ferrets/index.html>.

891. “Diseases from Ferrets,” *King County, WA Government*, last modified January 26, 2017, <https://kingcounty.gov/depts/health/communicable-diseases/zoonotic/facts-resources/diseases-by-animal/ferrets.aspx>.

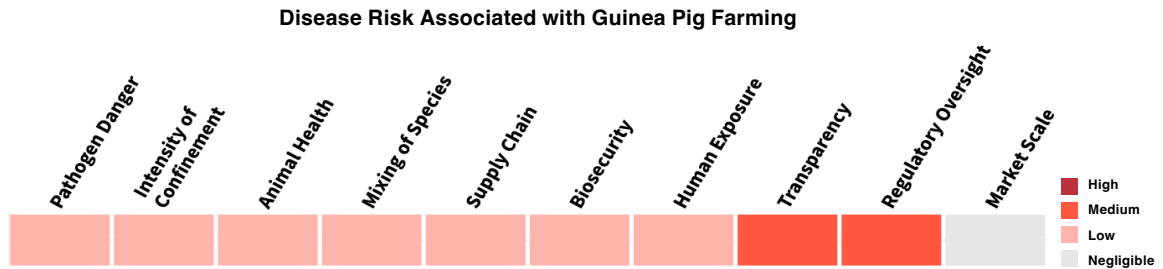
892. Ferrets can also be carriers of ringworm fungus and mites that can infect humans. “Ferrets,” *Centers for Disease Control and Prevention*, last modified March 8, 2022, <https://www.cdc.gov/healthypets/pets/ferrets/index.html>.

893. David Gaines, “Summary of State- And Territory-Level Ferret Regulations,” *American Ferret Association*, July 2009, <https://www.ferret.org/pdfs/general/2009-StateByState.pdf>.

894. Angela Drake, “Is America Ready for Farm-to-Table Guinea Pig?” *Modern Farmer*, December 8, 2015, <https://modernfarmer.com/2015/12/cuy/>.

895. “USDA Allows Abysmal Conditions to Persist at Pennsylvania Guinea Pig Breeders,” *Animal Welfare Institute Quarterly*, Winter 2020, <https://awionline.org/awi-quarterly/winter-2020/usda-allows-abysmal-conditions-persist-pennsylvania-guinea-pig-breeders>.

896. “USDA Allows Abysmal Conditions to Persist at Pennsylvania Guinea Pig Breeders,” *Animal Welfare Institute Quarterly*, Winter 2020, <https://awionline.org/awi-quarterly/winter-2020/usda-allows-abysmal-conditions-persist-pennsylvania-guinea-pig-breeders>.



In the United States, guinea pig is considered an exotic meat. This designation carries regulatory implications. As a “non-amenable species,” guinea pig meat is not subject to USDA inspection and falls instead under the jurisdiction of the FDA.⁸⁹⁷ However, where guinea pigs are considered pets or raised for research purposes, the USDA does have jurisdiction under the Animal Welfare Act. Breeders who derive over \$500 in gross income from the sale of guinea pigs in any calendar year are generally required to have a USDA license.⁸⁹⁸ Yet, many breeders do not obtain a license, in part because USDA APHIS does not closely monitor this industry.⁸⁹⁹

Guinea pigs have not been associated with severe disease outbreaks in the United States; however, they have been linked to multistate outbreaks of salmonellosis contracted from animals sold at pet stores.⁹⁰⁰ Lymphocytic Choriomeningitis Virus (LCMV) and Leptospirosis can be transmitted from guinea pigs to humans, though cases are extremely rare.^{901 902 903} These diseases are usually transmitted to humans through contact with infected feces or urine.

23. Rabbit Farming

Rabbits in the United States are raised for meat, wool, fur, and breeding stock as well as for sale as pets and for laboratory use. Youth programs such as 4-H often raise rabbits, and the animals are common classroom pets. There are over 4,000 rabbit farms in the United States that sell approximately 500,000 rabbits each year.⁹⁰⁴ Rabbit meat was a popular choice in the United States before the increase of beef consumption in the 1960s; however, rabbit meat has experienced a slight rebound in recent years.

897. Some states such as California prohibit the selling of any animal carcass for food that is commonly kept as a pet, but these laws have not yet been tested with respect to guinea pigs.

898. “Animal Welfare Act and Animal Welfare Regulations,” *USDA, APHIS Report APHIS 41-35-076*, May 2022, https://www.aphis.usda.gov/animal_welfare/downloads/AC_BlueBook_AWA_508_comp_version.pdf.

899. “USDA Allows Abysmal Conditions to Persist at Pennsylvania Guinea Pig Breeders,” *Animal Welfare Institute*, Winter 2020, <https://awionline.org/awi-quarterly/winter-2020/usda-allows-abysmal-conditions-persist-pennsylvania-guinea-pig-breeders>.

900. “Notes from the Field: Recurrence of a Multistate Outbreak of Salmonella Enteritidis Infections Linked to Contact with Guinea Pigs—Eight States, 2015-2017,” *CDC Morbidity and Mortality Weekly Report* 67, No. 42 (October 26, 2018): 1195-1196, <https://www.cdc.gov/mmwr/volumes/67/wr/mm6742a6.htm>.

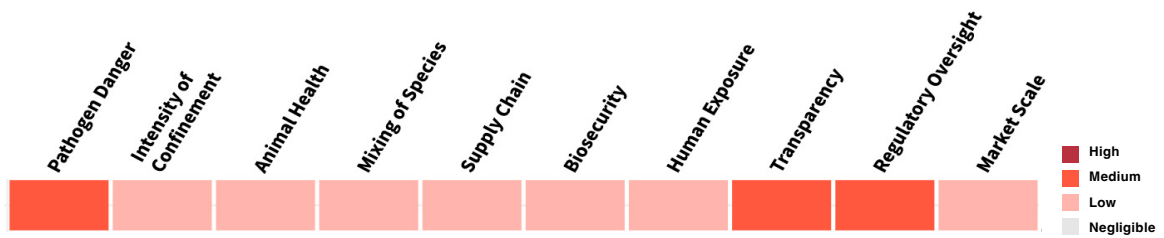
901. “Diseases from Your Pets, Both Common and Exotic,” *Stanford Children’s Health*, accessed May 31, 2023, <https://www.stanfordchildrens.org/en/topic/default?id=diseases-from-your-pets-both-common-and-exotic-1-2420>.

902. “Diseases from Rodents, Pocket Pets and Rabbits,” *King County Public Health*, accessed May 31, 2023, <https://kingcounty.gov/depts/health/communicable-diseases/zoonotic/facts-resources/diseases-by-animal/pocket-pets.aspx>.

903. “Lymphocytic Choriomeningitis (LCM),” *Centers for Disease Control and Prevention*, last updated May 6, 2014, <https://www.cdc.gov/vhf/lcm/>.

904. “Rabbits,” *USDA National Agriculture Library*, accessed May 31, 2023, <https://www.nal.usda.gov/afsic/rabbits>.

Disease Risk Associated with Rabbit Farming



Rabbits are kept in wire cages called “hutches” which are usually stacked at least two rows deep. Rabbits can start breeding as early as six or seven months of age. Given their relatively quick breeding cycle and large litter sizes (up to 12), one doe can be expected to wean up to 60 rabbits a year.⁹⁰⁵ When slaughtered on site at a rabbit farm, the rabbits are killed either by dislocating the neck or with a forceful blow to the skull behind the ears. To prepare a rabbit for consumption, the animal is hung by its back legs and bled by cutting off the head.⁹⁰⁶

Because rabbits sold for meat are classified as “non-amenable species,” they are exempt from USDA regulations governing slaughter of livestock.⁹⁰⁷ As a result, producers generally need only comply with state or local health codes to sell within their state, though the FDA regulates interstate sales.^{908 909} Most states require a license to process rabbits for human consumption, though some provide licenses without regular physical inspection of facilities.⁹¹⁰ By contrast, rabbits raised for pets or research are governed by the USDA under the Animal Welfare Act whereby the facilities are subject to physical inspection.



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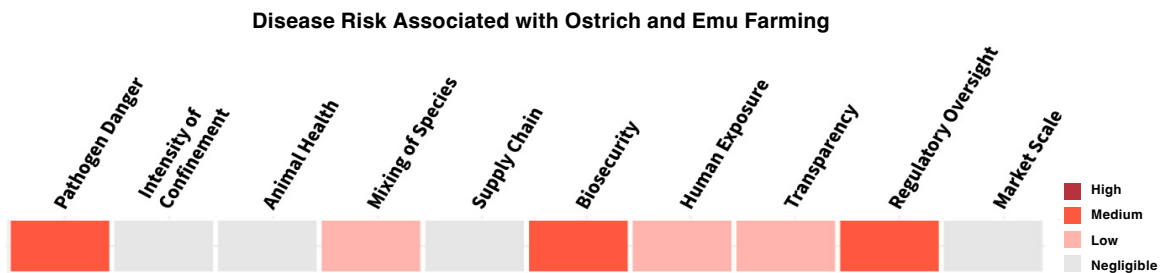
When disease occurs in rabbit farms, it is often attributable in part to poor care and management.⁹¹¹ Pathogens can spread quickly given the number of animals, level of confinement, and limited air flow. Depending on husbandry practices, there also may be potential opportunities for crossover between wild and domestic rabbits. It is not uncommon for rabbits to be raised along with other species, increasing possible sources for disease exposure. Rabbits can transmit pathogens through bites and scratches (such as pasteurellosis), skin-to-skin contact (such as ringworm), contact or accidental ingestion of fecal material from infected animals (such as cryptosporidiosis), and through

905. “Rabbit Tracks: Breeding Techniques and Management,” *Michigan State University Extension*, April 24, 2017, https://www.canr.msu.edu/resources/rabbit_tracks_breeding_techniques_and_management.
 906. “Slaughtering and Dressing Rabbits,” *Mississippi State University Extension*, accessed May 31, 2023, <https://extension.msstate.edu/node/25622>.
 907. “Rabbit From Farm to Table,” *USDA Food Safety and Inspection Service*, last modified March 12, 2015, <https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/meat/rabbit-farm-table>.
 908. “Non-Amenable Species Laws and Guidance,” *Association of Food and Drug Officials*, accessed May 31, 2023, <https://www.afdo.org/resources/non-amenable-species-laws-and-guidance/>.
 909. “How is Rabbit Meat Inspected?” *USDA AskUSDA*, March 9, 2023, <https://ask.usda.gov/s/article/How-is-rabbit-meat-inspected>.
 910. “On-Farm Processing of Chickens & Rabbits in Texas,” *Farm & Ranch Freedom Alliance*, September 4, 2019, <https://farmandranchfreedom.org/chicken-rabbit-processing-tx-2019/>.
 911. “Learn About Rabbit Diseases For Saving Your Bunnies,” *Roy’s Farm*, May 27, 2021, <https://www.roysfarm.com/rabbit-diseases/>.

aerosolization and inhalation of pathogens in contaminated soil (such as mycobacteriosis).⁹¹² Tularemia or “rabbit fever” is one disease of particular concern that can cause a range of symptoms from ulcers to pneumonia and can be fatal in humans if not diagnosed.⁹¹³ Tularemia is highly contagious—so much so that the CDC considers it a potential target for bioweapon producers.⁹¹⁴ It has been reported in every state except Hawaii. The United States sees roughly 200 human cases a year, mostly from wild rabbits. However, this number could increase exponentially if large populations of captive rabbits were to become infected.⁹¹⁵

24. Ratites: Ostrich and Emu Farming

Weighing up to 450 pounds and standing up to eight feet tall, the ostrich is the world’s largest bird, followed by the emu.⁹¹⁶ Both are members of a diverse group of flightless birds known as ratites. Ostrich and emu farming regained popularity in the 1990s as a way to diversify farming opportunities, particularly in the eastern United States.⁹¹⁷ These operations produce meat, eggs, oils, and other products. According to the 2017 Census of Agriculture, there are 212 ostrich farms and 1,535 emu farms in the United States, with most of these birds in Texas and California.⁹¹⁸ Since 2001, ratites have been subject to the requirements of the Poultry Products Inspection Act (PPIA), but farms slaughtering fewer than 1,000 birds per year and selling within the state are exempt from PPIA inspection requirements.⁹¹⁹ However, in order to sell ratite meat across state lines, birds must be slaughtered in a federally inspected meat processing plant.



There is a lack of data regarding diseases carried by ostriches and emus, and many tests commonly performed on poultry remain unvalidated for use on this unique group of birds. However, avian influenza viruses (AIVs) have been found in emus on farms in Texas and California.⁹²⁰ While that has not

912. “Zoonoses Associated with Rabbits,” *Office of the Campus Veterinarian and Institutional Animal Care and Use Committee*, January 2021, <https://iacuc.wsu.edu/zoonoses-associated-with-rabbits/>.

913. “Frequently Asked Questions (FAQ) About Tularemia,” *Centers for Disease Control and Prevention*, last updated April 4, 2018, <https://emergency.cdc.gov/agent/tularemia/faq.asp>.

914. “Frequently Asked Questions (FAQ) About Tularemia,” *Centers for Disease Control and Prevention*, last modified April 4, 2018, <https://emergency.cdc.gov/agent/tularemia/faq.asp>.

915. The highest risk of exposure would likely be to those gutting and processing the rabbits, but tularemia can also be transmitted through the food supply via ingestion of improperly cooked meat. Greg Cima, “Virus Killing Rabbits in Western U.S.,” *JAVMAnews*, July 15, 2020, <https://www.avma.org/javma-news/2020-07-15/virus-killing-rabbits-western-us>.

916. “Ostrich,” *National Geographic*, accessed May 31, 2023, <https://www.nationalgeographic.com/animals/birds/facts/ostrich>.

917. “Ostrich and Emu,” *Agriculture Marketing Resource Center*, November 2021, <https://www.agmrc.org/commodities-products/livestock/ostrich-and-emu-53585>.

918. “2017 Census of Agriculture United States Summary and State Data,” *USDA*, Volume 1, Geographic Area Series, Part 51, AC-17-A-51, April 2019, https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/usv1.pdf.

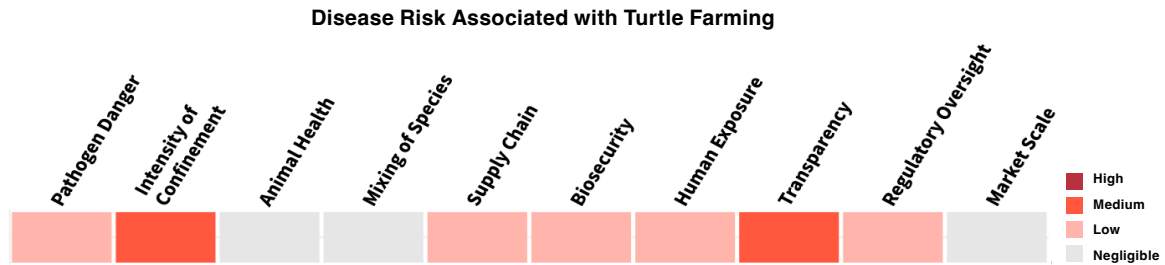
919. “Mandatory Inspection of Ratites and Squabs,” *Food Safety and Inspection Service*, May 7, 2001, <https://www.federalregister.gov/documents/2001/05/07/R1-10679/mandatory-inspection-of-ratites-and-squabs>.

920. B Panigrahy, D. A. Senne, J. E. Pearson, “Presence of Avian Influenza Virus (AIV) Subtypes H5N2 and H7N1 in Emus (*Dromaius novaehollandiae*) and Rheas (*Rhea americana*): Virus Isolation and Serologic Findings,” *Avian Dis* 39, No. 1 (January-March 1995): 64-67, <https://pubmed.ncbi.nlm.nih.gov/7794192/>.

yet been the case for ostriches in the United States, there are numerous reports of AIV in ostriches in Europe, Asia, and Africa.^{921 922}

25. Turtle Farming

Turtles have been raised in the United States as pets, for food, and for traditional medicine. In 1975, the FDA banned interstate trade of small turtles under four inches in length to help prevent the spread of salmonellosis, with exceptions to allow farmers to sell turtles within the country for educational, scientific, exhibition purposes, and for export.^{923 924} This restriction remains in place, though exports and sales of larger turtles continue, many of whom also carry *Salmonella*.^{925 926} The United States exported an estimated 17 million turtles from 2012 to 2016 (of which 16 million went through Louisiana).⁹²⁷ While there is limited data as to the animals’ origins, it is likely that many came from captive farms. Historically, the majority of U.S. turtle exports were shipped to Asia for human consumption; today, exports are down nearly 70% from a decade prior, mostly due to a decrease in prices of domestic turtle hatchlings in Asia.⁹²⁸



Most turtle farming takes place in the southeastern United States, with Louisiana leading all states in production volumes. There are reports of live soft-shelled turtles being offered for sale in food markets in many states including California, Louisiana, Florida, Pennsylvania, Minnesota, and New York, while turtle soup remains a fixture on menus across the Southeast.^{929 930 931}

Very little has been published on methods of turtle farming in the United States; however, one study of a Louisiana farm outlines the process. The farm used artificial ponds enclosed by sand

921. Dongdong Wang, Jingjing Wang, Yuhai Bi, Dandan Fan, et al., “Characterization of Avian Influenza H9N2 Viruses Isolated From Ostriches (*Struthio camelus*),” *Scientific Reports* 8, No. 2273 (February 2, 2018): <https://doi.org/10.1038/s41598-018-20645-1>.

922. Kyoko Shinya, Akiko Makino, Makoto Ozawa, Jin Hyun Kim, et al., “Ostrich Involvement in the Selection of H5N1 Influenza Virus Possessing Mammalian-Type Amino Acids in the PB2 Protein,” *Journal of Virology* 83, No. 24 (November 2009): <https://doi.org/10.1128/JVI.01714-09>.

923. Lauren E. Montague, Juliana M. Marcotrigiano, Niamh E. Keane, Hannah E. Marquardt, et al., “Online Sale of Small Turtles Circumvents Public Health Regulations in the United States,” *PLoS ONE* 17, No. 12 (2022): doi: 10.1371/journal.pone.0278443.

924. “Salmonella and Turtle Safety,” *U.S. Food and Drug Administration*, last updated August 9, 2022, <https://www.fda.gov/animal-veterinary/animal-health-literacy/salmonella-and-turtle-safety>.

925. Code of Federal Regulations, Title 21, Chapter I, Subchapter L, Part 1240.62, accessed June 3, 2021, [https://www.ecfr.gov/cgi-bin/text-idx?SID=8c2f7610c9f7330b0b5424c0294198d8&mc=true&node=pt21.8.1240_162](https://www.ecfr.gov/cgi-bin/text-idx?SID=8c2f7610c9f7330b0b5424c0294198d8&mc=true&node=pt21.8.1240&rgn=div5#se21.8.1240_162).

926. “Salmonella and Turtle Safety,” *US Food and Drug Administration*, last modified August 9, 2022, <https://www.fda.gov/animal-veterinary/animal-health-literacy/salmonella-and-turtle-safety>.

927. Jani Hall, “Will America’s Turtles Be Eaten Into Extinction?” *National Geographic*, November 10, 2016, <https://www.nationalgeographic.com/animals/article/wildlife-watch-freshwater-turtles-louisiana-trade>.

928. Ivana Mali, Hsiao-Hsuan Wang, William E. Grant, Mark Feldman, et al., “Modeling Commercial Freshwater Turtle Production on US Farms for Pet and Meat Markets,” *PloS ONE* 10, No. 9 (September 25, 2015): <https://doi.org/10.1371/journal.pone.0139053>.

929. David McCowan, “Why Have Americans Stopped Eating Turtle?” *The Takeout*, March 26, 2018, <https://thetakeout.com/why-have-americans-stopped-eating-turtle-1798346325>.

930. Dina Fine Maron, “Live Animal Markets in San Francisco Accused of Mistreatment,” *National Geographic*, August 15, 2022, <https://www.nationalgeographic.com/animals/article/live-animal-markets-in-san-francisco-accused-of-mistreatment>.

931. Louise Boyle, “New York City Urged to Shut Down 80 Live Animal Markets Amid Fresh Pandemic Fears,” *Independent*, May 7, 2020, <https://www.independent.co.uk/climate-change/news/new-york-live-animal-wet-market-coronavirus-wildlife-pandemic-disease-a9500796.html>.

beaches stocked with turtles at a high density of 12,500 turtles per hectare (equivalent to about two and a half football fields) or more than eight turtles per square foot.⁹³² As turtle eggs are deposited in the sand, workers remove them to be incubated indoors. Farms may sell both hatchlings and yearlings. Hatchlings (newborn turtles) are exported or sold illegally in the United States, often through unmonitored websites.⁹³³ Other young turtles are moved to indoor ponds for a year, whereupon they are large enough to be sold legally through the domestic pet market. A turtle farm may sell about 325,000 new hatchlings and 55,000 yearlings annually.⁹³⁴

People can pick up pathogens from turtles by touching them, their water, supplies, or areas where they live; turtles can appear healthy but still carry disease.⁹³⁵ The most common zoonotic disease found in turtles is salmonellosis, which is often present on turtle skin as well as the surface of their shell. Human infection occurs through direct contact with turtles or their droppings, infected tank water, or habitat. Transmission from turtles is common. For example, in 2020, the CDC reported that 26 people across 14 states were infected in one such outbreak of salmonellosis obtained from pet store turtles.⁹³⁶ Though many reptiles carry *Salmonella*, turtles are perhaps the most likely to be handled by small children, for whom the infection can be more severe.⁹³⁷



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932. Ivana Mali, Hsiao-Hsuan Wang, William E. Grant, Mark Feldman, et al., “Modeling Commercial Freshwater Turtle Production on US Farms for Pet and Meat Markets,” *PLoS ONE* 10, No. 9 (2015): doi:10.1371/journal.pone.0139053.

933. “URI Students’ Research Finds Illegal Sale of Pet Turtles in U.S. Has Found a Niche on the Web,” University of Rhode Island, January 30, 2023, <https://www.uri.edu/news/2023/01/uri-students-research-finds-illegal-sale-of-pet-turtles-in-u-s-has-found-a-niche-on-the-web/>.

934. Ivana Mali, Hsiao-Hsuan Wang, William E. Grant, Mark Feldman, et al., “Modeling Commercial Freshwater Turtle Production on US Farms for Pet and Meat Markets,” *PLoS ONE* 10, No. 9 (2015): doi:10.1371/journal.pone.0139053.

935. “Tiny Turtles and Salmonella,” *Centers for Disease Control and Prevention*, last updated November 16, 2022, <https://www.cdc.gov/healthypets/pets/reptiles/trouble-with-tiny-turtles.html>.

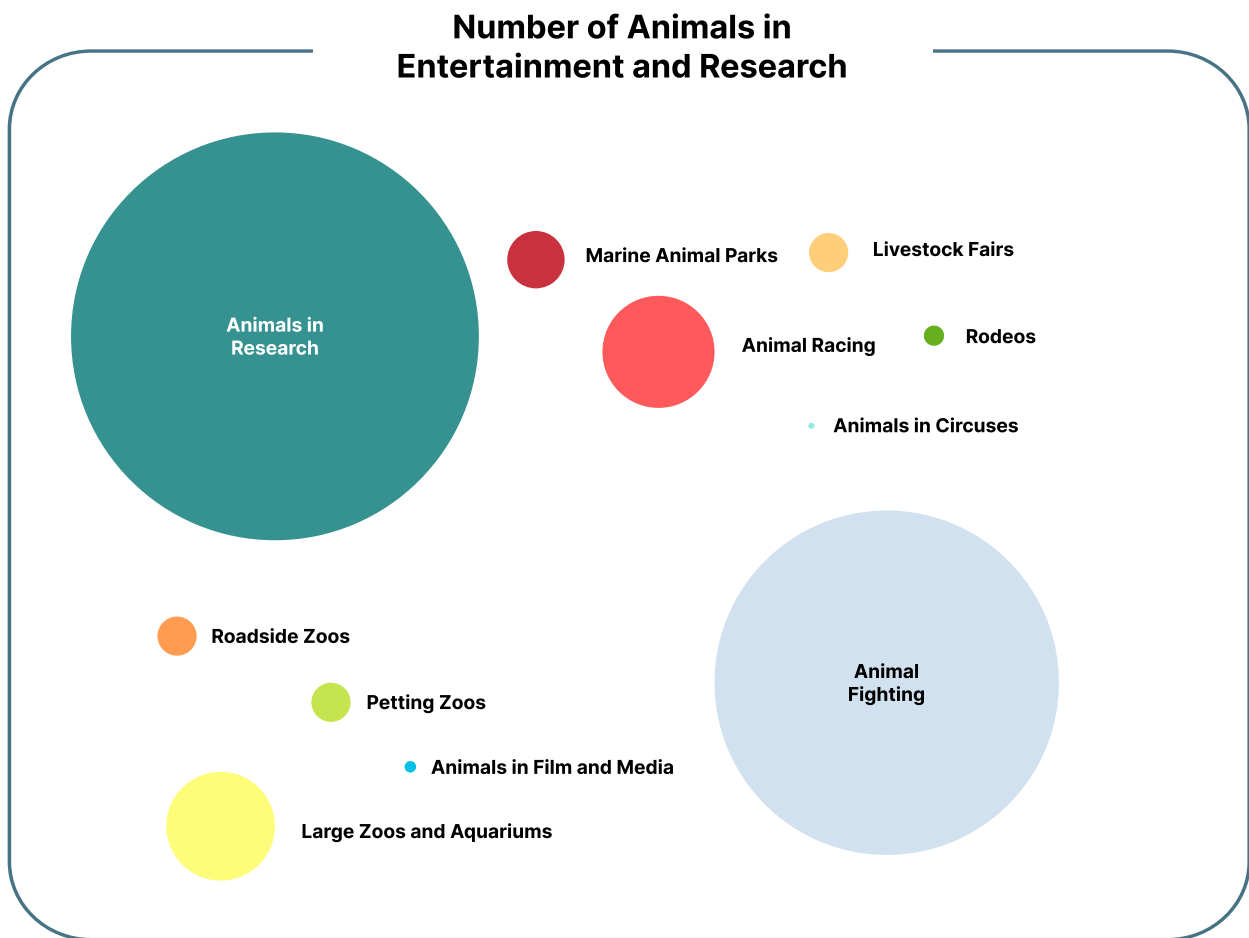
936. “Outbreak of Salmonella Infections Linked to Pet Turtles,” *Centers for Disease Control and Prevention*, last modified January 9, 2020, <https://www.cdc.gov/salmonella/oranienburg-10-19/index.html>.

937. Transmission can also occur when parents interact with a turtle and then hold their child. “Pet Turtles: A Common Source of Salmonella,” *Center for Veterinary Medicine FDA*, October 2008, <https://permanent.fdlp.gov/gpo23324/TurtleBrochureNot508.pdf>.



Entertainment and Research

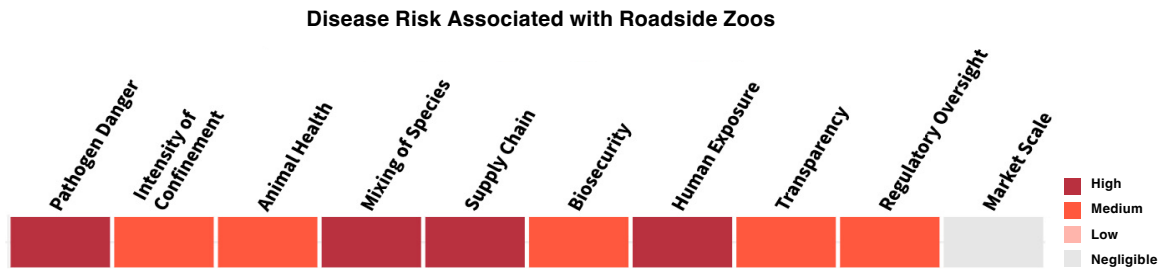
A number of animals in the United States are bred and maintained for human entertainment or for research purposes. The use of animals in entertainment takes a myriad of forms from circuses and rodeos, to zoos and marine parks, to activities such as livestock fairs and animal races, and other hands-on experiences with animals. In recent years, social media has been flooded with photos and videos of animals creating new genres of content and new forms of demand. Direct human-animal interaction is a hallmark of many of the industries that use animals as entertainment, including aquarium touch tanks, drive-through petting zoos, bull riding, and dolphin encounters. In this section, we discuss a range of markets where people pay a fee to interact with animals, observe animals, exhibit animals, or compete with animals. In addition, we examine the use of animals in research, where animals are employed to advance other human goals.



- Animals in Research, 11 million animals
- Animal Fighting, 8 million animals
- Animal Racing, 840,000 animals
- Large Zoos and Aquariums, 800,000 animals
- Marine Animal Parks, 220,000 animals
- Roadside Zoos, 102,000 animals
- Livestock Fairs, 100,000 animals
- Petting Zoos, 100,000 animals
- Rodeos, 26,000 animals
- Animals in Film and Media, 8,000 animals
- Animals in Circuses, 1,000 animals

26. Roadside Zoos

Roadside zoos are collections of animals held in confinement for display to paying visitors. Roadside zoos do not meet the same animal care standards as zoos accredited by AZA (Association of Zoos and Aquariums). Animals at roadside zoos are often held in cages or small makeshift enclosures.⁹³⁸ Tigers, for example, may be held on a concrete slab with a kiddie pool, while younger animals might be kept in a dog crate.⁹³⁹ Many if not most roadside zoos allow for direct contact between animals and the public. Visitors pay to touch, feed, or play with the animals, in particular baby animals. These activities are especially popular with children, who may take fewer sanitary precautions to mitigate zoonotic risk. Unlike sanctuaries, roadside zoos may breed and sell animals for commercial purposes.⁹⁴⁰



Thousands of these operations dot the American countryside, where many advertise on billboards to attract passing motorists. Today some take the form of traveling exhibitions where operators bring animals to fairs, parties, and promotional events. The precise number of roadside zoos is not known as many may operate informally without a license. While historically these facilities were stocked with farm animals and native wildlife, many roadside zoos today supply a wide range of exotic species for entertainment. In 2020, roadside zoos were thrust into the spotlight with the premiere of the Netflix series, *Tiger King*, which focused on one such establishment that was involved in the cub petting industry and big cat trade more generally. In light of growing public concern about such practices, many roadside zoos have become increasingly wary of negative publicity, with some going so far as to prohibit recording and require visitors to sign non-disclosure agreements prior to entry.⁹⁴¹



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938. While the industry purports to support conservation efforts, critics suggest that holding captive animals has little conservation value and, in some cases, may be undermining conservation where animals in zoos are sourced from the wild. Carney Anne Nasser, “Welcome To The Jungle: How Loopholes In The Federal Endangered Species Act And Animal Welfare Act Are Feeding A Tiger Crisis In America,” *Global Language Review* 9, No. 1 (April 14, 2016), <https://www.albanygovernmentlawreview.org/article/23971-welcome-to-the-jungle-how-loopholes-in-the-federal-endangered-species-act-and-animal-welfare-act-are-feeding-a-tiger-crisis-in-america>.

939. Justin Jouvenal, “Mauling, Escapes and Abuse: 6 Small Zoos, 80 Sick or Dead Animals” *The Washington Post*, September 18, 2015, https://www.washingtonpost.com/local/crime/mauling-escapes-and-abuse-6-small-zoos-80-sick-or-dead-animals/2015/09/18/df46110-2581-11e5-b77f-eb13a215f593_story.html.

940. The two can be difficult to distinguish, and some roadside zoos present themselves as sanctuaries.

941. Jennifer Jacquet, “America, Stop Visiting Roadside Zoos—They Make Money from the Inhumane Treatment of Animals,” *The Guardian*, November 27, 2016, <https://www.theguardian.com/sustainable-business/2016/nov/27/roadside-zoos-america-animal-cruelty-welfare>.

Roadside zoos combine a myriad of risk factors making them ripe environments for zoonotic transmission.



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Roadside zoos combine a myriad of risk factors making them ripe environments for zoonotic transmission. These operations are often marked by substandard animal care, including poor nutrition, health, and housing, all of which lead to chronic stress, weaker immune systems, and an increased likelihood of disease. Multiple species held in close confinement further augments the risk. At the same time, roadside zoos offer the opportunity for intimate human-animal interactions, the kind that give rise to disease transmission, in a landscape that is both lacking in sanitation and largely devoid of regulation.

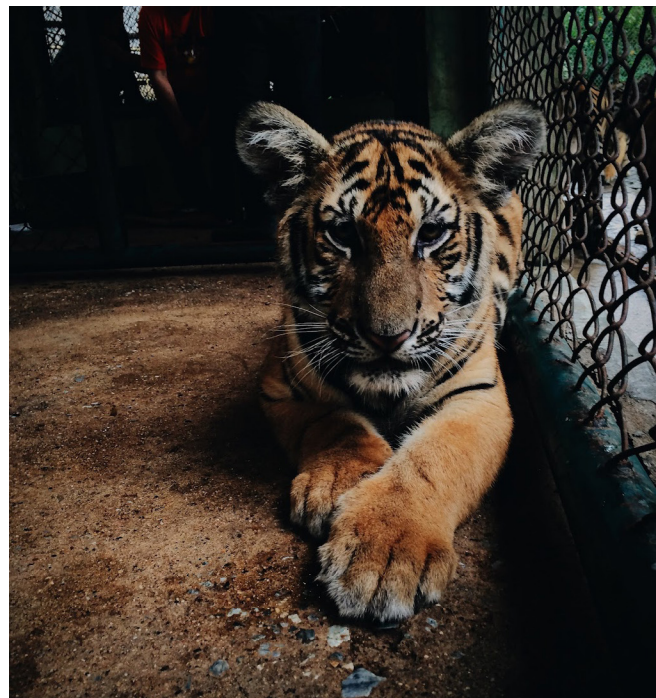
Disease exposure at roadside zoos can occur anytime there is direct contact between animals and the public, for example, through touching, holding, or feeding an animal, as well as by being licked, bitten, or scratched.⁹⁴² In addition, indirect transmission can also occur through inhaling airborne pathogens or interacting with pathogens in the animal's food, water, or environment.⁹⁴³ In such cases, a child might infect herself by picking up contaminated hay in an animal's pen then touching her face, for example.⁹⁴⁴ Roadside petting zoos have been linked to numerous zoonotic outbreaks in the United States, including bacterial infections caused by *Escherichia coli*, *Salmonella*, *Coxiella burnetii*, *Cryptosporidium*, *Giardia*, *Campylobacter*, and a variety of viruses, as well as fungal infections.^{945 946} Exposure to *E. coli*, for example, can cause bloody diarrhea, anemia, or neurological impairments such as seizures or strokes, and children have been hospitalized and died as a result of such exposure at roadside zoos.⁹⁴⁷

The risk of disease spread is fueled in part by the number of visitors that each animal might interact with daily as well as the frequency with which animals move through these operations. For instance, one bear cub, who was infected with rabies, was used in a roadside zoo and was found to have interacted with 400 people across 10 states in the one month before he died.⁹⁴⁸ These risks are amplified by the fact that many of

942. For example, the Austin Aquarium, a for-profit zoo in Texas which allows guests to touch and interact with animals, has received several citations from the USDA after children were bitten while handling primates, including lemurs, as well as a kinkajou. A pending complaint, filed with the Federal Trade Commission, alleges that over the course of a four month investigation there were 34 incidents in which guests or employees were bitten, scratched, or injured. "People for the Ethical Treatment of Animals, Petitioner v. Austin Aquarium, LLC, Respondent," *Complaint to the Federal Trade Commission*, December 5, 2022, <https://www.peta.org/wp-content/uploads/2022/12/2022-12-05-federal-trade-commission-austin-aquarium-complaint.pdf>.
943. The National Association of State Public Health Veterinarians Animal Contact Compendium Committee, Russell F. Daly, Jennifer House, Danielle Stanek, et al., "Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2017," *Journal of the American Veterinary Medical Association* 251, No. 11 (December 2017): <https://doi.org/10.2460/javma.251.11.1268>.
944. J. Scott Weese, Lisa McCarthy, Michael Mossop, Hayley Martin, et al., "Observation of Practices at Petting Zoos and the Potential Impact on Zoonotic Disease Transmission," *Clinical Infectious Diseases* 45, No. 1 (July 1, 2007): 10-15, <https://doi.org/10.1086/518572>.
945. Jonathan Stirling, Michael Griffith, James S.G. Dooley, Colin E. Goldsmith, et al., "Zoonoses Associated with Petting Farms and Open Zoos," *Vector-Borne and Zoonotic Diseases* 8, No. 1 (Feb. 2008): 85-92, <http://doi.org.ezp-prod1.hul.harvard.edu/10.1089/vbz.2006.0639>.
946. "Compendium of Measures to Prevent Disease Associated with Animals in Public Settings," *CDC MMWR*, 2009, <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5805a1.htm>.
947. "Health Hazards of Petting Zoos," *People for the Ethical Treatment of Animals*, accessed September 16, 2022, <https://www.peta.org/wp-content/uploads/2021/02/petting-zoo-factsheet.pdf>.
948. Jonathan Stirling, Michael Griffith, James S.G. Dooley, Colin E. Goldsmith, et al., "Zoonoses Associated with Petting Farms and Open Zoos," *Vector Borne and Zoonotic Diseases* 8, No. 1 (Spring 2008): 85-92, <https://doi.org/10.1089/vbz.2006.0639>.

the operators and animal handlers who staff roadside zoos are inexperienced and uninformed about disease risk and animal husbandry.⁹⁴⁹

The Animal Welfare Act is the only piece of federal legislation aimed at regulating animal exhibitors.⁹⁵⁰ However, the law protects only a fraction of the species displayed at roadside zoos, exempting large categories of reptiles, amphibians, fish, birds, and invertebrates.^{951 952} In addition, the Act only includes specific requirements for certain species but not others, while the Act's general requirements are considered minimal.⁹⁵³ Compliance with the AWA is limited at best. Historically, as many as 60% of USDA inspections found violations that resulted in citations—violations that are reported on a USDA inspection report.⁹⁵⁴ If a violation is particularly serious and/or it has not been remedied within 90 days, an official warning letter will be issued. If the violations are still not remedied, fines and a loss of license can result.⁹⁵⁵ Fines by the USDA under the Animal Welfare Act generally amount to no more than a few thousand dollars, however, and often do not serve as any practical deterrent. The Office of the Inspector General of the USDA has found that the USDA frequently issues penalties on the low end of the acceptable range as prescribed and has stated: “Dealers and other facilities had little incentive to comply with AWA because monetary penalties were, in some cases, arbitrarily reduced and were often so low that violators regarded them as a cost of business.”⁹⁵⁶ Many roadside zoos charge \$50 or more for visitors to take photos with exotic animals and hundreds more for “play sessions” and other hands-on experiences. A single tiger cub may bring in \$3,000 a day or more in profit, enough to make any fines from inspections trivial.⁹⁵⁷



A single tiger cub may bring in \$3,000 a day or more in profit, enough to make any fines from inspections trivial.

949. Justin Jouvenal, “Mauling, Escapes and Abuse: 6 Small Zoos, 80 Sick or Dead Animals” *The Washington Post*, September 18, 2015, https://www.washingtonpost.com/local/crime/mauling-escapes-and-abuse-6-small-zoos-80-sick-or-dead-animals/2015/09/18/df46f10-2581-11e5-b77f-eb13a215f593_story.html.

950. In recent years, the Endangered Species Act has been applied to certain captive species of conservation concern.

951. Andrew D Cardon, Matthew R Bailey, and B Taylor Bennett, “The Animal Welfare Act: From Enactment to Enforcement,” *Journal of the American Association for Laboratory Animal Science* 51, No. 3 (May 2012): 301-305, <https://pubmed.ncbi.nlm.nih.gov/22776186/>.

952. In 2000, the Congress directed the USDA to include birds, not bred for research, within the scope of the AWA and to promulgate rules to this effect. However, twenty years later, the agency has yet to do so, though this may soon change with a 2020 court order. Case No. 1:18-cv-01138 (TNM) American Anti-Vivisection Society v USDA, Filed Filed May 26, 2020, <https://thebrooksinstitute.org/sites/default/files/article/2020-06/AAVS%20Order%20-%20To%20Accompany%202020-06-08%20Digest%20Issue%20No%2034.pdf>.

953. Rebecca L. Jodidio, “The Animal Welfare Act Is Lacking: How to Update the Federal Statute to Improve Zoo Animal Welfare,” *Golden Gate University Environmental Law Journal* 13, No. 1 (2021): <https://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1155&context=gguelj>.

954. “USDA Urgently Needs Upward Trajectory in Enforcement of Animal Protection Laws,” *Animal Welfare Institute*, Spring 2021, <https://awionline.org/awi-quarterly/spring-2021/usda-urgently-needs-upward-trajectory-enforcement-animal-protection-laws>.

955. Andrew D Cardon, Matthew R Bailey, and B Taylor Bennett, “The Animal Welfare Act: From Enactment to Enforcement,” *J Am Assoc Lab Anim Sci*, 51, No. 3 (May 2012): 301-305, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3358977/>.

956. “Animal and Plant Health Inspection Service Animal Care Program Inspections of Problematic Dealers,” *Office of Inspector General, USDA*, Audit Report 33002-4-SF, May 2010, <https://www.usda.gov/sites/default/files/33002-4-SF.pdf>.

957. Jennifer Jacquet, “America, Stop Visiting Roadside Zoos—They Make Money from the Inhumane Treatment of Animals,” *The Guardian*, November 27, 2016, <https://www.theguardian.com/sustainable-business/2016/nov/27/roadside-zoos-america-animal-cruelty-welfare>.

In addition, Animal Welfare Act enforcement has steeply declined beginning in 2015.⁹⁵⁸ In the years since, enforcement actions have fallen by 90%.⁹⁵⁹ Under a new strategic guidance, the USDA sought to prioritize commercial interests of animal enterprises and “minimize costs” associated with violations of the law.⁹⁶⁰ Some inspectors have suggested that, in recent years, they were directed to overlook non-compliance and avoid issuing citations.⁹⁶¹ The change in directives culminated in what one former USDA assistant director dubbed “a systematic dismantling of [the] animal welfare inspection process and enforcement.”⁹⁶²

Animal Welfare Act: Enforcement Trends Since 2015



27. Livestock Fairs

State and county fairs as well as other forms of animal exhibitions such as “jackpot” shows are held across the country, often during the summer months and most commonly in the Midwest.⁹⁶³ The Minnesota State Fair, for example, draws more than 2,000,000 visitors annually, more than 35% of the state’s population.⁹⁶⁴ While fairs offer a range of activities from carnival games to vegetable growing contests, the presence of livestock animals is a hallmark of these events.⁹⁶⁵ Most fairs feature the exhibition of livestock often in contests, displays, and petting zoos.

Disease Risk Associated with Livestock Fairs

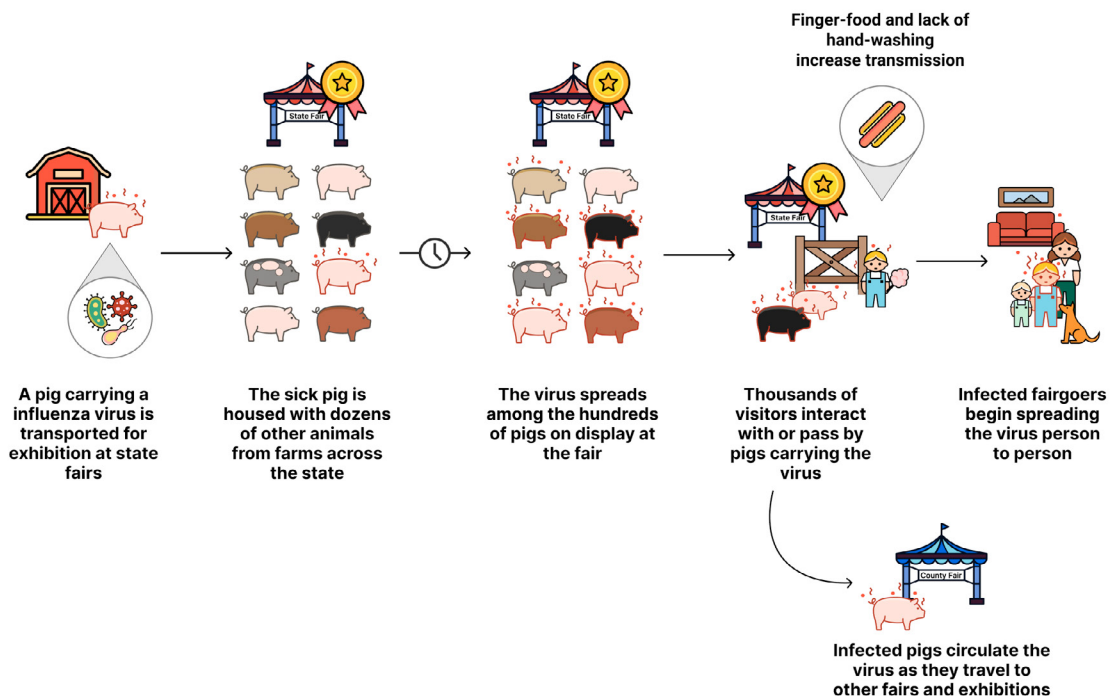


958. Enforcement rates have increased some since their low point in 2016, but it is still meaningfully uninforced.
 959. Rachel Fobar, “USDA Accused of Ignoring Animal Welfare Violations in Favor of Business Interests,” *National Geographic*, October 13, 2021, <https://www.nationalgeographic.com/animals/article/usda-accused-of-ignoring-animal-welfare-for-business-interests>.
 960. Rachel Fobar, “USDA Accused of Ignoring Animal Welfare Violations in Favor of Business Interests,” *National Geographic*, October 13, 2021, <https://www.nationalgeographic.com/animals/article/usda-accused-of-ignoring-animal-welfare-for-business-interests>.
 961. Rachel Fobar, “USDA Accused of Ignoring Animal Welfare Violations in Favor of Business Interests,” *National Geographic*, October 13, 2021, <https://www.nationalgeographic.com/animals/article/usda-accused-of-ignoring-animal-welfare-for-business-interests>.
 962. Rachel Fobar, “USDA Accused of Ignoring Animal Welfare Violations in Favor of Business Interests,” *National Geographic*, October 13, 2021, <https://www.nationalgeographic.com/animals/article/usda-accused-of-ignoring-animal-welfare-for-business-interests>.
 963. A jackpot show is one in which the entry fees are used to pay the judges, award cash prizes, and cover other show costs.
 964. “Attendance,” *Minnesota State Fair*, accessed May 31, 2023, <https://www.mnstatefair.org/about-the-fair/attendance/>.
 965. Some animals are touched only by their handlers, while others are available to the public or used in hands-on demonstrations, such as milking a cow.

Agricultural fairs can create an ideal environment for disease spread, with hundreds or thousands of animals brought together from different owners across the state. Still, the majority of exhibitors report that they do not disinfect pens or shared equipment that their animals use when attending these shows.⁹⁶⁶ Fairs allow pathogens opportunities to move from livestock to humans through close interaction with visitors, owners, and various youth groups who raise animals for the fair, such as 4-H or Future Farmers of America. Fairs are almost never limited to one species of animal, which presents additional opportunities for the spread of viruses. Perhaps the most dangerous of these combinations is poultry and swine, as pigs are susceptible to many forms of avian influenza and provide an ideal mixing vessel for the creation of novel strains of influenza virus.⁹⁶⁷ Over the last decade, following the 2009 H1N1 swine flu epidemic, the United States has recorded the highest number of swine-origin influenza infections of any country in the world.⁹⁶⁸ The vast majority of these infections occurred in youth swine exhibitors at state and county fairs.⁹⁶⁹ Roughly 18% of swine at county fairs test positive for influenza A.⁹⁷⁰

Agricultural fairs can create an ideal environment for disease spread, with hundreds or thousands of animals brought together from different owners across the state.

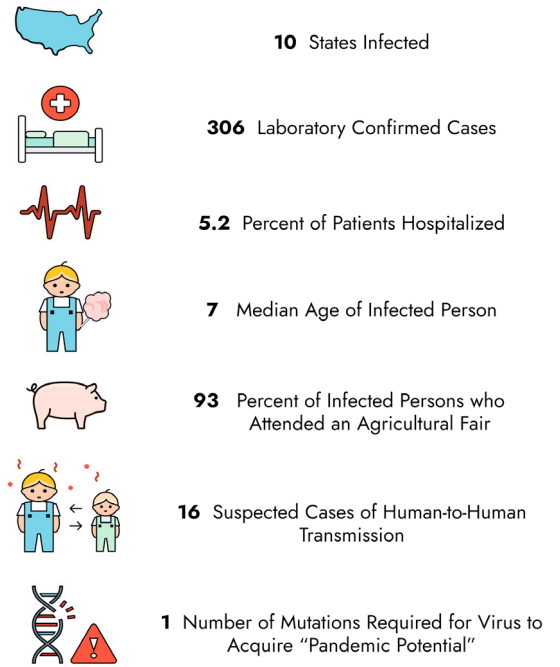
Viral Influenza Spread through Livestock Exhibitions at State Fairs



966. Diane Larson, "Biosecurity and Zoonotic Disease Risk at Livestock Exhibition Events," *Kansas Department of Agriculture Division of Animal Health, Master of Public Health Field Experience Report* (2017), <https://krex.k-state.edu/dspace/handle/2097/35588>.
 967. Dillon S McBride, Amanda C Perofsky, Jacqueline M Nolting, Martha I Nelson, et al., "Tracing the Source of Influenza A Virus Zoonoses in Interconnected Circuits of Swine Exhibitions," *Journal of Infectious Diseases* 224, No. 3 (August 2021): 458-468, <https://doi.org/10.1093/infdis/jiab122>.
 968. Dillon S McBride, Amanda C Perofsky, Jacqueline M Nolting, Martha I Nelson, et al., "Tracing the Source of Influenza A Virus Zoonoses in Interconnected Circuits of Swine Exhibitions," *Journal of Infectious Diseases* 224, No. 3 (August 2021): 458-468, <https://doi.org/10.1093/infdis/jiab122>.
 969. Dillon S McBride, Amanda C Perofsky, Jacqueline M Nolting, Martha I Nelson, et al., "Tracing the Source of Influenza A Virus Zoonoses in Interconnected Circuits of Swine Exhibitions," *Journal of Infectious Diseases* 224, No. 3 (August 2021): 458-468, <https://doi.org/10.1093/infdis/jiab122>.
 970. Dillon S McBride, Amanda C Perofsky, Jacqueline M Nolting, Martha I Nelson, et al., "Tracing the Source of Influenza A Virus Zoonoses in Interconnected Circuits of Swine Exhibitions," *Journal of Infectious Diseases* 224, No. 3 (August 2021): 458-468, <https://doi.org/10.1093/infdis/jiab122>.

These findings are particularly troubling because influenza A is a single-strand RNA virus that carries “pandemic potential,” in that it may have the ability to spread easily from person to person.⁹⁷¹ Outbreaks of such viruses through agricultural fairs may disproportionately affect children. Take, for example, the H3N2v strain, which spread across hundreds of people in 10 states with suspected person-to-person transmission: 93% of those infected had contact with swine at an agricultural fair and the median patient age was just seven years old.⁹⁷² This outbreak led to scores of hospitalizations and, in one instance, death. Still, animal fairs remain largely unregulated—exempt from federal regulation including the Animal Welfare Act.⁹⁷³ After a fair, some animals go home or are sent to auction, while many others continue to another fair as part of a larger circuit, as infection rates build throughout the season.⁹⁷⁴

By the Numbers: U.S. Outbreak of H3N2v



28. Petting Zoos

Other types of animal fairs, such as petting zoos, are usually geared toward children. Petting zoos are enclosures containing tame animals often including species such as sheep, goats, pigs, alpacas, ducks, chicken, and ponies for individuals to touch, interact with, and feed. Some petting zoos also include a wide range of exotic species. Typically, food pellets are sold for patrons to hand-feed to the animals. Petting zoos may be part of a larger fair or formal zoo, but many are standalone or traveling operations.

Disease Risk Associated with Petting Zoos



971. Mathilde Richard and Ron A.M. Fouchier, “Influenza A Virus Transmission Via Respiratory Aerosols or Droplets as it Relates to Pandemic Potential,” *FEMS Microbiol* 40, No. 1 (January 1, 2016): 68-85, doi: 10.1093/femsre/fuv039.

972. Michael A. Jhung, Scott Epperson, Matthew Biggerstaff, Donna Allen, et al., “Outbreak of Variant Influenza A(H3N2) Virus in the United States,” *Clinical Infectious Diseases* 57, No. 12 (September 2013): 1703-1712, <https://doi.org/10.1093/cid/cit649>.

973. “Management Guidelines for Avian Influenza: Zoological Parks & Exhibitors Outbreak Management Plan,” *USDA APHIS AZA*, version 322, September 2009, <https://zahp.org/wp-content/uploads/2021/02/AI-Outbreak-Management-Plan-for-Zoological-Parks-and-Exhibitors.v322.1.31.17.pdf>.

974. Jackpot shows, which take place earlier in the season, prior to state and country fairs, have been shown to increase infection rates, creating upstream zoonotic risk. Dillon S McBride, Amanda C Perofsky, Jacqueline M Nolting, Martha I Nelson, et al., “Tracing the Source of Influenza A Virus Zoonoses in Interconnected Circuits of Swine Exhibitions,” *Journal of Infectious Diseases* 224, No. 3 (August 2021): 458-468, <https://doi.org/10.1093/infdis/jiab122>.

Petting zoos can be fertile grounds for zoonotic disease transmission, particularly of bacterial infections caused by *E. coli*, *Salmonella*, *Cryptosporidium*, *Giardia*, and *Campylobacter*.⁹⁷⁵ Most commonly, transmission occurs through the fecal/oral route as children become infected either through contact with the animals themselves, with the animal's environment, or other contaminated surfaces.⁹⁷⁶ Past studies have shown a correlation between children falling down or sitting on the ground in petting zoos and zoonotic illness.^{977 978} Similarly, *E. coli* can sometimes be found on shoes, strollers, toys, and pacifiers after visiting a petting zoo, while other pathogens may remain in the environment for months or even years.⁹⁷⁹



Several risk factors increase the likelihood of disease transmission at petting zoos. Animals are more likely to shed higher levels of pathogens due to stress caused by transportation, confinement, and handling.⁹⁸⁰ Housing multiple animals and multiple species together in a small space allows pathogens to spread more easily, particularly among young animals with limited immune systems.

Human behavior at petting zoos also amplifies zoonotic risk. For example, one study found that 74% of visitors had direct contact with animals while 87% had contact with

contaminated surfaces in animal enclosures. In addition, 49% of visitors touched their face and 22% ate or drank while in the animal area. However, afterwards, just over a third of visitors washed or sanitized their hands.⁹⁸¹ These statistics are particularly troubling because, in the same study, 63% of environmental samples taken at six different petting zoo sites involved in the study tested positive for *Salmonella*, and 6% were positive for *E. coli*.⁹⁸² The CDC cautions that children under five and pregnant women are at highest risk for serious infections and should follow strict precautions if attending petting zoos.⁹⁸³

975. "Communicable Disease Control Guidelines for Prevention of Zoonotic Diseases from Petting Zoos and Open Farms," *BC Center for Disease Control*, March 2011, <http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/PettingZoos.pdf>.

976. John R. Dunn, "Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2011," *National Association of State Public Health Veterinarians, Inc.*, CDC Recommendation and Report 60 (RR04); 1-24. May 6, 2011, <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6004a1.htm>.

977. J. Scott Weese, Lisa McCarthy, Michael Mossop, Hayley Martin, et al., "Observation of Practices at Petting Zoos and the Potential Impact on Zoonotic Disease Transmission," *Clinical Infectious Diseases* 45, No. 1 (July 1, 2007): 10-15, <https://doi.org/10.1086/518572>.

978. G. Erdozain, K. KuKanich, B. Chapman, and D. Powell, "Observation of Public Health Risk Behaviours, Risk Communication and Hand Hygiene at Kansas and Missouri Petting Zoos – 2010-2011," *Zoonoses and Public Health* 60 (2013): 304-310, doi: 10.1111/j.1863-2378.2012.01531.

979. John R. Dunn, "Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2011," *National Association of State Public Health Veterinarians, Inc.*, CDC Recommendation and Report 60 (RR04); 1-24. May 6, 2011, <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6004a1.htm>.

980. John R. Dunn, "Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2011," *National Association of State Public Health Veterinarians, Inc.*, CDC Recommendation and Report 60 (RR04); 1-24. May 6, 2011, <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6004a1.htm>.

981. Marcy McMillian, John R Dunn, James E Keen, Karen L Brady, et al., "Risk Behaviors for Disease Transmission Among Petting Zoo Attendees," *Journal of the American Veterinary Medical Association* 231, no. 7 (October 2007): <https://doi.org/10.2460/javma.231.7.1036>.

982. Marcy McMillian, John R Dunn, James E Keen, Karen L Brady, et al., "Risk Behaviors for Disease Transmission Among Petting Zoo Attendees," *Journal of the American Veterinary Medical Association* 231, no. 7 (October 2007): <https://doi.org/10.2460/javma.231.7.1036>.

983. "Outbreaks of *Escherichia coli* O157:H7 Infections Among Children Associated With Farm Visits—Pennsylvania and Washington, 2000," *MMWR Weekly CDC* 50, No. 15 (April 20, 2011): 293-7, <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5015a5.htm>.

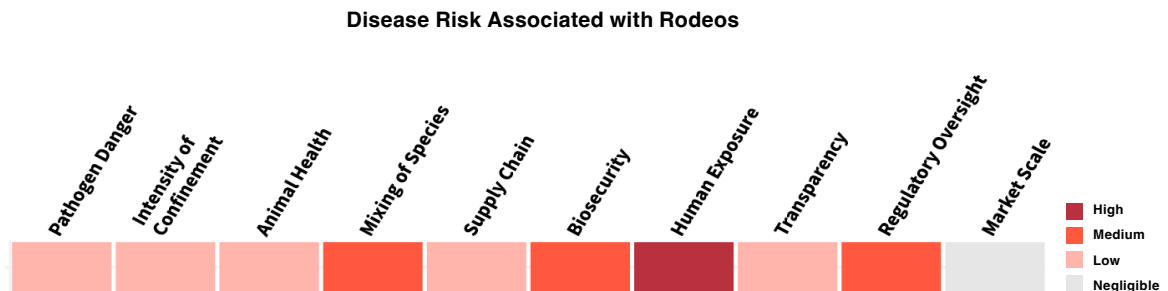
However, beyond these suggested guidelines for visitors, regulation surrounding petting zoos is lax.⁹⁸⁴ The CDC notes that “no federal laws exist that address this public health issue” and found that of the 44 states that responded to a national survey, “none had laws to control exposure of humans to pathogens at venues where the public has access to farm animals.”^{985 986} While bacterial infections commonly found at petting zoos pose serious, sometimes fatal, health risks to visitors, they do not carry “pandemic potential” and are unlikely to spread easily person to person.⁹⁸⁷

29. Rodeos

Rodeos, another form of animal-based entertainment, typically include some combination of bull riding, bronco riding, steer wrestling, calf roping, and team roping done for sport and prize money. They can be stand alone events or put on as part of a larger state or country fair. Animals traditionally used in rodeos include cows and horses as well as other livestock.⁹⁸⁸ Rodeos are most common in the American West and Southwest. The largest rodeo in the world takes place annually in Houston, Texas and attracts more than two million visitors over the course of the 20-day annual event.⁹⁸⁹ More than 600 smaller events take place in the United States each year, including the Angola Prison Rodeo where the inmates participate in a number of different competitions including trying to capture a poker chip tied to a bull.⁹⁹⁰ Rodeos have been criticized by some as cruel; still, they remain a cultural tradition in many parts of the United States.



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984. Though petting zoos are required to be licensed under the AWA, many temporary exhibits operate without one.

985. “Outbreaks of Escherichia coli O157:H7 Infections Among Children Associated With Farm Visits—Pennsylvania and Washington, 2000,” *MMWR Weekly CDC* 50, No. 15 (April 20, 2011): 293-7, <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5015a5.htm>.

986. Seven states require some kind of handwashing or hygiene station to be available at petting zoos. Diane Larson, “Biosecurity and Zoonotic Disease Risk at Livestock Exhibition Events,” *Kansas Department of Agriculture Division of Animal Health*, Master of Public Health Field Experience Report (2017), <https://krex.k-state.edu/dspace/handle/2097/35588>.

987. Jonathan Stirling, Michael Griffith, James S G Dooley, Colin E Goldsmith, et al., “Zoonoses Associated with Petting Farms and Open Zoos,” *Vector Borne and Zoonotic Diseases* 8, No. 1 (Spring 2008): 85-92, <https://doi.org/10.1089/vbz.2006.0639>.

988. Madison Steffey, “Detailed Discussion of Rodeos,” *Michigan State University College of Law*, 2018, <https://www.animallaw.info/article/detailed-discussion-rodeos>.

989. Houston Livestock Show and Rodeo, accessed June 4, 2022, <https://www.rodeohouston.com>.

990. Angola Rodeo, accessed June 4, 2022, <http://www.angolarodeo.com/?q=Events>.

Rodeo animals carry a range of bacterial, fungal, and viral diseases. For example, feral pigs, which are often chased and tackled in rodeo events, have been shown to carry *Brucellosis*, *Leptospirosis*, *Salmonellosis*, tularemia, influenza A, and vesicular stomatitis, all of which are transmissible to humans.⁹⁹¹ Zoonotic transmission can occur when rodeo participants come into contact with animals' blood or other fluids, either during competitions, where injuries are common, or while

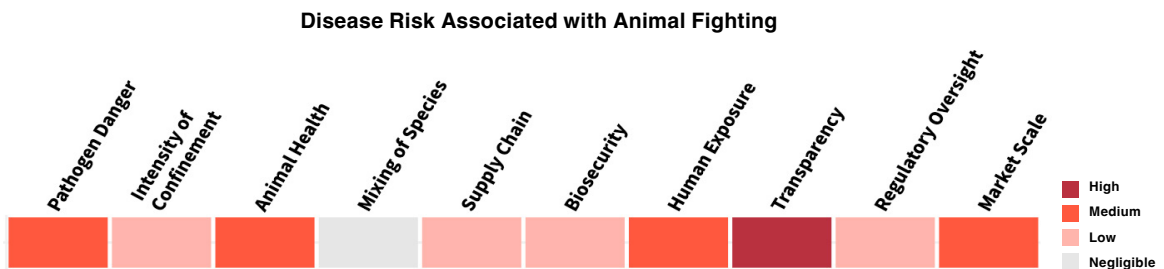
animals are prepared for transport to slaughter. However, much of the zoonotic risk from these events stems from a lack of sanitation. Visitors may touch and interact with a range of livestock species without washing their hands. Often finger food such as hot dogs or cotton candy is sold near animal petting stations. Children, particularly young children, who may put their hands in their mouth, are at greatest risk.

The federal government does not regulate rodeos. While the Animal Welfare Act generally covers livestock used for entertainment, the law specifically exempts rodeos and exhibitions of agricultural animals.⁹⁹² States have been reluctant to regulate rodeos for either human or animal protection in part because of their cultural status.

Children, particularly young children, who may put their hands in their mouth, are at greatest risk.

30. Animal Fighting

Though animal fighting is illegal in the United States, it is estimated that tens of thousands of people are still actively involved in the practice.⁹⁹³ The most common forms of fighting involve dogs, roosters (known as cockfighting), and, less commonly, pigs. The USDA notes that “a substantial component of backyard poultry is made up by the gamefowl (cockfighting) industry” estimating that nationally this industry may comprise some eight to 24 million birds, though assessing the true size of the industry is extremely difficult given its illicit nature.⁹⁹⁴ Online connections have made it easier for fighters to share information about fights while avoiding law enforcement.



Animal fights are formal or informal events where two or more animals are trained or driven to attack one another at the behest of their owners. Oftentimes, the fights last until one animal is dead or unable to continue. Animal fighting in the United States is largely limited to dogs and roosters, but sometimes pigs are also included in fights. In a “hog-dog fight,” one or more dogs are provoked to fight

991. David Perle, “Zoonotic Disease Warning Issued Over ‘Ham Rodeo,’” *People for the Ethical Treatment of Animals*, February 18, 2020, <https://www.peta.org/media/news-releases/zoonotic-disease-warning-issued-over-ham-rodeo/>.

992. “Animal Welfare Act Guidelines for County and State Fairs,” *USDA Animal and Plant Health Inspection Service*, July 2009, <https://naldc.nal.usda.gov/download/32779/PDF>.

993. “A Closer Look at Dogfighting,” *ASPCA*, accessed May 31, 2023, <https://www.aspc.org/animal-cruelty/dogfighting/closer-look-dogfighting>.

994. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/emergency_management/downloads/documents_manuals/poultry_ind_manual.pdf.

a wild boar or pig. It is suggested that hog-dog fights regularly occur in 10 southern states.^{995 996} In the case of cockfighting, steel razor blades or “gaffs” are tied to the birds’ legs to make the fights more lethal.⁹⁹⁷ Cockfighting is particularly prevalent in the Appalachian communities as well as Hispanic communities from California to Texas and across the South.^{998 999} Cockfighting is also prevalent in Hawaii.¹⁰⁰⁰ Many individuals involved in fighting breed and maintain a stock of animals at their residence.¹⁰⁰¹

Dog fighting and cockfighting have both been outlawed in all 50 states as well as at the federal level.¹⁰⁰² However, legal loopholes and enforcement challenges continue to undermine these laws’ effectiveness.¹⁰⁰³ Due in part to the clandestine nature of the activity, these events are notoriously difficult to monitor, as they often occur on large tracts of private land.^{1004 1005}

Though animal fighting is a relatively small market, it may convey significant zoonotic risk to those individuals involved in the practice because they are directly exposed to blood and other fluids. Participants regularly handle injured animals or animal carcasses and, without proper sanitation, could easily become infected with any pathogens that the animal carried. Cockfighting operations in particular may allow for the transmission of avian influenza and other highly contagious diseases.¹⁰⁰⁶ These concerns are augmented by a distinct lack of veterinary care and transparency.¹⁰⁰⁷ It was not until the 2002-2003 outbreak of Newcastle disease that the cockfighting industry and its movements came to be better understood by regulators. At the time, the industry was estimated to be worth \$50 million in California alone and used a sophisticated system to transport birds illegally despite the state and federal quarantines in place.¹⁰⁰⁸



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995. These states include: Alabama, Arizona, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina, and Texas. “Animal Fighting Facts” *American Legal Defense Fund*, accessed May 31, 2023, <https://aldf.org/article/animal-fighting-facts/>.

996. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/emergency_management/downloads/documents_manuals/poultry_ind_manual.pdf.

997. The cockfighting season operates primarily from Thanksgiving through July.

998. Hal Herzog, *Some We Love, Some We Hate, Some We Eat* (New York: HarperCollins, 2010).

999. Cockfighting is illegal throughout the United States, but owning a fighting bird is allowed in 11 states. Attending a cockfight as a spectator is not a crime in seven states. Sydney Goldstein, “Is Cockfighting Legal in the United States?” *LawInfo*, October 14, 2020, <https://www.lawinfo.com/resources/criminal-law-federal/is-cockfighting-legal-in-the-united-states.html>.

1000. Christina Jedra, “The Battle Against Cockfighting In Hawaii: Lax Enforcement Helps Foster An Attitude Of ‘What’s Wrong With It?’” *Honolulu Civil Beat*, April 23, 2023, <https://www.civilbeat.org/2023/04/the-battle-against-cockfighting-in-hawaii-lax-enforcement-helps-foster-an-attitude-of-whats-wrong-with-it/>.

1001. Hal Herzog, *Some We Love, Some We Hate, Some We Eat* (New York: HarperCollins, 2010).

1002. 7 U.S.C. § 2156 - U.S. Code - Unannotated Title 7. Agriculture § 2156. Animal fighting venture prohibition.

1003. These laws are difficult to enforce for a number of reasons. First, simply owning a large number of animals (such as roosters) is not a crime. And to obtain convictions in such cases, offenders must be caught in the act of fighting or have similarly strong evidence tying them to the crime itself. Fights often occur in clandestine locations that are not visible to the public or accessible to law enforcement without a warrant. In the case of cockfighting especially, fights often occur in rural remote areas on large tracts of private land making it difficult to monitor and nearly impossible to enforce the laws without inside information.

1004. “Animal Fighting,” *National Humane Education Society*, accessed May 31, 2023, <https://www.nhes.org/animal-fighting/>.

1005. “Animal Fighting: State Laws,” *American Legal Defense Fund*, accessed May 31, 2023, <https://aldf.org/article/animal-fighting-facts/animal-fighting-state-laws/>.

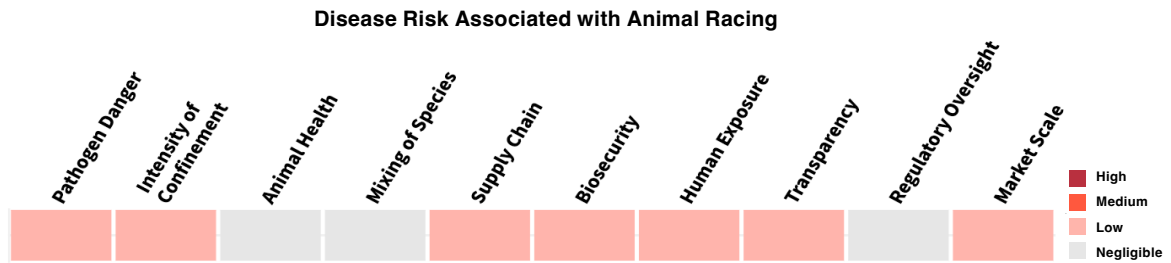
1006. Wayne Pacelle, “Cockfights Provide Ringside Seats for Transmitting Avian Influenza and Other Diseases,” *Center for a Humane Economy*, April 1, 2020, <https://centerforahumaneconomy.org/2020/04/01/cockfights-provide-ringside-seats-for-transmitting-avian-influenza-and-other-diseases/>.

1007. Dogs rescued during dogfight investigations have been found to carry a broad range of parasites (including *Babesia gibsoni* and heartworm), in part because they lacked access to veterinary care; however, these particular parasitic diseases are not zoonotic in nature. S.H. Cannon, J.K. Levy, S.K. Kirk, P.C. Crawford, et al., “Infectious Diseases in Dogs Rescued During Dogfighting Investigations,” *Veterinary Journal* 211 (May 2016): 64–69, <https://doi.org/10.1016/j.tvjl.2016.02.012>.

1008. Larry Allen, “Backyard Poultry Industry. Chapter 5, Poultry Industry Manual: Foreign Animal Disease Preparedness & Response Plan,” *USDA*, March 2013, https://www.aphis.usda.gov/animal_health/emergency_management/downloads/documents_manuals/poultry_ind_manual.pdf.

31. Animal Racing

Horse and greyhound racing were once popular events in the United States, though both have experienced a significant decline in recent years. There are approximately 100 horse racetracks of varying size across the United States. These racetracks generate over \$3 billion in revenue annually and employ over 16,000 people. This figure, however, does not include the roughly \$11 billion wagered on horse races each year.¹⁰⁰⁹ An estimated 1.3 million horses are kept for racing, though not all of these animals make it to the track.¹⁰¹⁰ Somewhere around 1,000 of these horses die annually from race-related activities.¹⁰¹¹ Greyhound racing, by comparison, is a dramatically smaller industry with only 2,000 dogs racing at four tracks in 2020.¹⁰¹³ ¹⁰¹⁴



Horses may live for up to 30 years, but they typically race for no more than four. This excess supply of horses, who can no longer compete, has meant that horses bred for the racing industry are sometimes slaughtered for human or animal consumption. Though the use of horses for meat production is, for all practical purposes, illegal in the United States, operators circumvent the ban by shipping the horses out of the country to Canada or Mexico for slaughter.¹⁰¹⁵ Horses sold at livestock auctions in the United States sometimes end up at slaughter, and certain auctions are organized for the purpose of selling horses to buyers who drive the horses in trailers to Canada or Mexico where such slaughter is legal. It is estimated that from 2008 to 2018 an average of about 130,000 horses were exported annually for meat production.¹⁰¹⁶

It is estimated that from 2008 to 2018 an average of about 130,000 horses were exported annually for meat production.

1009. "States With Legal Horse Betting," *Legal Sports Betting*, last updated May 31, 2023, <https://www.legalsportsbetting.com/states-with-horse-betting/>.
 1010. "The Horse Industry by the Numbers," *Equo*, Jan 16, 2017, <https://www.ridewiththequo.com/blog/the-horse-industry-by-the-numbers>.
 1011. Patrick Battuello, "The Time For Horse Racing Has Passed. It's Time to Outlaw It," *The Washington Post*, October 8, 2019, retrieved September 28, 2021 from https://www.washingtonpost.com/opinions/the-staggering-toll-in-dead-horses-makes-it-clear-its-time-to-outlaw-horse-racing/2019/10/08/b0f97a06-e52c-11e9-a331-2df12d56a80b_story.html.
 1012. In April and May 2023, 12 horses died at Churchill Downs in Kentucky, including two the week of the Kentucky Derby. Investigators are still trying to determine the causes of these deaths, but many believe trainers are incentivized (by purse winnings, betting protocols, etc) to race unhealthy horses, which may have had some impact on these deaths. Joe Drape, "Churchill Downs to Cease Racing as It Investigates Deaths of Horses," *The New York Times*, June 2, 2023, <https://www.nytimes.com/2023/06/02/sports/horse-racing/churchill-downs-deaths-horseracing.html>.
 1013. Florida, Arkansas, and Iowa closed their greyhound racetracks by 2022, leaving West Virginia as the last state with remaining active racetracks. Craig Pittman, "The Era of Greyhound Racing in the U.S. is Coming to an End," *National Geographic*, October 1, 2020, <https://www.nationalgeographic.com/animals/article/greyhound-racing-decline-united-states>; Natalie Voss, "Going The Way Of The Greyhounds?" *Paulick Report*, February 7, 2023, <https://paulickreport.com/news/the-biz/going-the-way-of-the-greyhounds/>.
 1014. April Simpson, "Once One of America's Favorite Pastimes, Greyhound Racing Eats Dust," *Pew Trusts Stateline Article*, October 29, 2019, <https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/10/29/once-one-of-americas-favorite-pastimes-greyhound-racing-eats-dust>.
 1015. All meat products processed for sale across state lines must be inspected by the USDA, and a congressional ban on USDA funding for horse meat inspections was one of the primary reasons that all remaining horse slaughter facilities closed after 2011. The ban has since been lifted, but there have been no new requests for inspections. Phil Derfler, "Setting the Record Straight on Congress' Lifting of the Ban on Horse Slaughter," *USDA Food Safety and Inspection Service*, February 21, 2017, <https://www.usda.gov/media/blog/2011/12/09/setting-record-straight-congress-lifting-ban-horse-slaughter>.
 1016. Patrick Battuello, "The Time For Horse Racing Has Passed. It's Time to Outlaw It," *The Washington Post*, October 8, 2019, retrieved September 28, 2021 from https://www.washingtonpost.com/opinions/the-staggering-toll-in-dead-horses-makes-it-clear-its-time-to-outlaw-horse-racing/2019/10/08/b0f97a06-e52c-11e9-a331-2df12d56a80b_story.html.



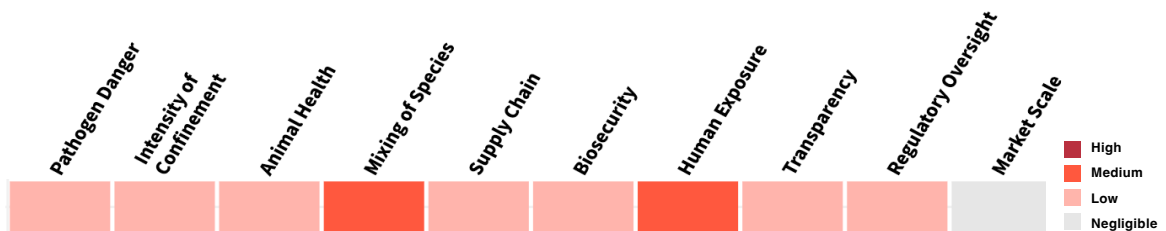
While the horseracing industry has given rise to zoonotic outbreaks overseas, in particular Hendra virus, which caused the death of horse owners, trainers, and veterinarians in Australia, the zoonotic risk from animal racing is relatively low.^{1017 1018} Horses can be vectors for zoonotic diseases such as glanders, rabies, brucellosis, and leptospirosis.^{1019 1020} Still, these diseases require close contact, making veterinarians, trainers, jockeys, and stable hands the most at-risk groups for equine-human transmission.¹⁰²¹

Historically, neither horse nor dog racing were federally regulated.¹⁰²² But in 2020, Congress passed the Horseracing Integrity and Safety Act, a law that primarily targets doping on the part of the horse racing industry. Seven states have banned all betting on horse races (both in person and online), and 42 states have outlawed greyhound racing.^{1023 1024}

32. Animals in Circuses

Animals in circuses are trained to perform tricks or stunts for paying audiences. After Ringling Brothers closed in 2017, many other circuses followed suit, as states and major cities took steps to ban the use of certain animal training tools and wild animals, in particular elephants, in traveling acts.^{1025 1026} There are still circuses in business today that travel around the United States with captive wildlife.¹⁰²⁷

Disease Risk Associated with Animals in Circuses



1017. Diana Mendez, Petra Buttner, and Rick Spearea, "Hendra Virus in Queensland, Australia, During the Winter of 2011: Veterinarians on the Path to Better Management Strategies," *Prev Vet Med.* 117, No. 1 (November 1, 2014): 40-51, doi: 10.1016/j.prevetmed.2014.08.002.

1018. "Summary of Human Cases of Hendra Virus Infection," *NSW Government Health*, last updated March 28, 2022, <https://www.health.nsw.gov.au/Infectious/controlguideline/Pages/hendra-case-summary.aspx>.

1019. Alexandra Sack, Fatai S. Oladunni, Battsetseg Gonchigoo, Thomas M. Chambers, et al., "Zoonotic Diseases from Horses: A Systematic Review," *Vector Borne Zoonotic Dis.* 20, No. 7 (July 2020): 484-495, doi: 10.1089/vbz.2019.2541.

1020. "Glanders," *Centers for Disease Control and Prevention*, last updated October 31, 2017, <https://www.cdc.gov/glanders/index.html>.

1021. Kenneth Marcella, "Zoonotic Diseases: Horses to Humans," *DVM360*, November 30, 2009, <https://www.dvm360.com/view/study-links-bone-loss-to-proximal-sesamoid-fractures-in-racehorses>.

1022. Both horse and dog racing are exempt from The Animal Welfare Act. "USDA Animal Care: Animal Welfare Act and Animal Welfare Regulations," *USDA Animal and Plant Health Inspection Service*, APHIS 41-35-076, May 2022, https://www.aphis.usda.gov/animal_welfare/downloads/AC_BlueBook_AWA_508_comp_version.pdf.

1023. Greyhound Racing in the United States," *GREY2K USA*, accessed May 11, 2023, <https://www.grey2kusa.org/about/states.php>.

1024. "States with Legal Horse Betting," *Legal Sports Betting*, last updated May 6, 2023, <https://www.legalsportsbetting.com/states-with-horse-betting/>.

1025. These bans are enacted by prohibiting the use of bullhooks, a long pole with a sharp hook on the end that circuses rely on to control and punish elephants. "Bans on Circuses," *FOUR PAWS in US*, accessed May 31, 2023, <https://www.four-paws.us/campaigns-topics/topics/wild-animals/worldwide-circus-bans>.

1026. Ringling Brothers announced they will be reopening their shows in 2023 but will not be using animals in the shows. Alison Fox, "Ringling Bros. Circus Is Returning After a Years-long Hiatus—Without Animals," *Travel & Leisure*, May 29, 2022, <https://www.travelandleisure.com/attractions/ringling-brothers-relaunch-animal-free-show>.

1027. See <https://www.loomisircus.com>, <http://www.thejordanworldcircus.com>, <https://spectacularcircus.com>, <https://royalhannefordcircus.org>, accessed June 4, 2022.

Circuses have frequently given rise to animal-induced injuries, but the risk level of zoonotic transmission is relatively low, particularly given how few circuses involving animals exist today.¹⁰²⁸ Still, there is risk. Circuses frequently include multiple species and entail close animal interaction with trainers. The transport process may also carry risks. Pathogens such as Tuberculosis (TB) have been transmitted from circus elephants to humans.¹⁰²⁹

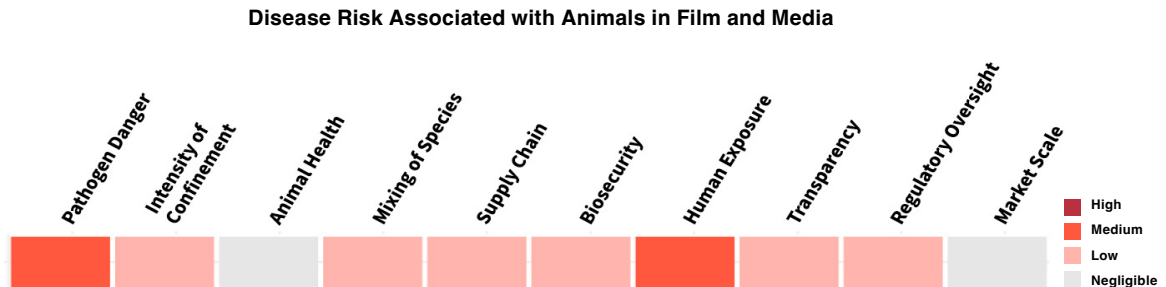
USDA APHIS regulates circuses under the Animal Welfare Act. However, apart from USDA inspections that happen on an irregular basis (though mandated at least once a year), circuses operate with little federal oversight. As of May 2023, on the local level, over 150 jurisdictions across 37 states had imposed full or partial bans on using wild animals in circuses.^{1030 1031}



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33. Animals in Film and Media

Animal use in movies, television, and advertisements have become increasingly commonplace in recent years. Species both wild and domestic are kept for the purpose of performing. While the relative zoonotic risk posed by animals used in film is limited due to the industry’s small size, owners and trainers, who often live and work closely with the animals, may still have significant disease exposure, in particular those who interact with multiple species or high-risk species.



Of larger scale and concern is the growing space of social media, where content involving animals is an immensely popular genre. Posts involving animals have been found to have higher levels of engagement, driving “likes” and, ultimately, demand for animals through other types of animal markets, in particular the exotic pet trade.¹⁰³² Social media can also foster misperceptions about animals and encourage human-animal interactions that may be dangerous and carry zoonotic risks. Videos of wildlife and exotic animals touching, licking, biting, and playing with humans are commonplace on many of

1028. “Congress Briefing: Public Health & Safety: Public Health and Safety Issues Associated With the Use of Exotic and Non-Domesticated Animals in Traveling Circuses,” *Animal Defenders International*, accessed May 31, 2023, https://www.federalcircusbill.org/wp-content/uploads/2014/04/2-Congress-Brief-Public-Safety-F_April-2014.pdf.

1029. Rachel Fobar, “Captive Elephants Can Spread Tuberculosis to Humans—An Issue That’s Been Ignored,” *National Geographic*, September 4, 2020, <https://www.nationalgeographic.com/animals/article/threat-of-tuberculosis-transmission-looms-in-captive-elephants>.

1030. “Congress Briefing: Public Health & Safety: Public Health and Safety Issues Associated With the Use of Exotic and Non-Domesticated Animals in Traveling Circuses,” *Animal Defenders International*, accessed May 31, 2023, https://www.federalcircusbill.org/wp-content/uploads/2014/04/2-Congress-Brief-Public-Safety-F_April-2014.pdf.

1031. “Bans on Circuses,” *FOUR PAWS in US*, accessed May 31, 2023, <https://www.four-paws.us/campaigns-topics/topics/wild-animals/worldwide-circus-bans>.

1032. How Pets Create Winning Content for Brands on Instagram,” *NewsWhip*, May 26, 2016, <https://www.newswhip.com/2016/05/instagram-pets-brands-engagement/>.



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these forums and serve to normalize these types of interactions among the general public.¹⁰³³ Whole industries cater to serve this demand. For example, staged wildlife photography operations allow customers to select an animal to photograph from a menu of options. Handlers bring the animal from its cage to a large enclosure where customers can photograph the animal as if it was in the wild, sometimes paying hundreds of dollars for a single session with species such as clouded leopards or mountain lions.

Social media sites such as Facebook, TikTok, and YouTube have committed to removing flagged content that violates platform guidelines, which could be construed to include content such as misleading animal videos or depictions linked to the illegal wildlife trade. However, none have gone so far as to enforce bans on such content and any monitoring that does occur has historically been ad hoc and arbitrary.^{1034 1035} Technology that can effectively scan and identify problematic content is already in use in other fields.

While no federal or state guidelines specifically target the use of animals in film, several laws, including the Animal Welfare Act and the Endangered Species Act at the federal level as well as state cruelty laws, apply to various extents.¹⁰³⁶ The industry-based American Humane Association has guidelines to protect animals in film, but adherence to these guidelines is purely voluntary and their effectiveness has been questioned as the majority of harmful animal-human interactions may occur offscreen during training.¹⁰³⁷

34. Large Zoos and Aquariums

Large zoos and aquariums are found throughout the United States and marked by the presence of permanent enclosures with a wide variety of species types held for public viewing. Just under 240 of these facilities are accredited by the Association of Zoos and Aquariums (AZA).¹⁰³⁸ Combined, they attract 200 million visitors annually.¹⁰³⁹ However, a far greater number of institutions, such as Niabi Zoo in Illinois, the shopping mall aquarium chain SeaQuest, and Salisbury Zoo in Maryland, are not accredited by the AZA.^{1040 1041}

1033. Georgia Kate Moloney, Jonathan Tuke, Eleonora Dal Grande, Torben Nielsen, et al., "Is YouTube Promoting the Exotic Pet Trade? Analysis of the Global Public Perception of Popular YouTube Videos Featuring Threatened Exotic Animals," *PLoS ONE* 16, No. 4 (April 13, 2021): <https://doi.org/10.1371/journal.pone.0235451>.

1034. Natasha Daly, "Helping Kids Deal with Animal Exploitation on Social Media," *National Geographic*, May 21, 2021, <https://www.nationalgeographic.com/family/article/helping-kids-deal-with-animal-exploitation-on-social-media>.

1035. Elizabeth Dwojski, "YouTube's Arbitrary Standards: Stars Keep Making Money Even After Breaking the Rules," *The Washington Post*, August 9, 2019, <https://www.washingtonpost.com/technology/2019/08/09/youtubes-arbitrary-standards-stars-keep-making-money-even-after-breaking-rules/>.

1036. Vincent Rizzo, "Overview of Laws Concerning Animals in Film Media," *Animal Legal & Historical Center* (2012), <https://www.animallaw.info/article/overview-laws-concerning-animals-film-media>.

1037. Vincent Rizzo, "Overview of Laws Concerning Animals in Film Media," *Michigan State University College of Law*, 2012, <https://www.animallaw.info/article/overview-laws-concerning-animals-film-media>.

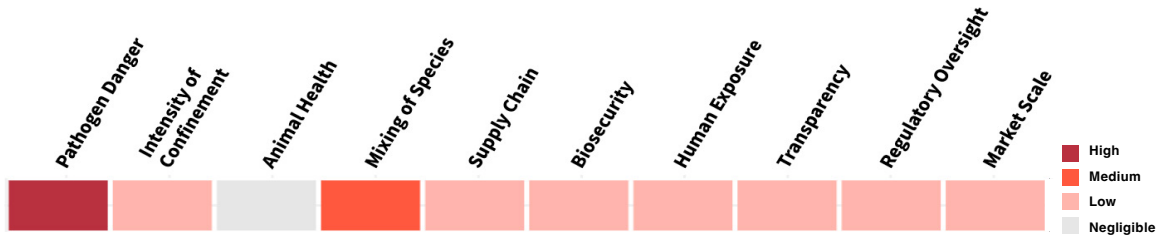
1038. "Currently Accredited Zoos and Aquariums," *Association of Zoos and Aquariums*, accessed May 9, 2023, <https://www.aza.org/current-accreditation-list>.

1039. "About Us," *Association of Zoos and Aquariums*, accessed May 9, 2023, <https://www.aza.org/about-us>.

1040. The Columbus Zoo, a flagship AZA institution, lost its AZA accreditation in 2022 after a documentary exposed its close ties with roadside zoos it used to supply exotic animals for Jack Hanna's late night television show appearances. "AZA Statement on AZA Accreditation Commission's Denial of Accreditation to Columbus Zoo and Aquarium," *Association of Zoos and Aquariums*, October 6, 2021, <https://www.aza.org/aza-news-releases/posts/aza-statement-on-aza-accreditation-commissions-denial-of-accreditation-to-columbus-zoo-and-aquarium?locale=en>.

1041. "Accreditation FAQs," *Association of Zoos and Aquariums*, accessed May 15, 2023, <https://www.aza.org/accred-faq>.

Disease Risk Associated with Large Zoos and Aquariums



Many zoos that do not meet the qualifications for AZA accreditation will obtain a certification from the Zoological Association of America (ZAA) or another organization with less demanding standards. Non-AZA accredited zoos outnumber accredited AZA zoos almost 10 to one.^{1042 1043} Despite the similarity in name between the Association of Zoos and Aquariums (AZA) and the Zoological Association of America (ZAA), which confuses many members of the public, the AZA differs markedly from the ZAA in that it imposes far stricter guidelines for safety as well as animal care.¹⁰⁴⁴ Because the Animal Welfare Act is the only federal law governing most zoo animals, voluntary membership and accreditation programs like the Association of Zoos and Aquariums are used to fill this regulatory gap.



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Other accreditation programs like the ZAA have been criticized for offering no more than a rubber stamp, intended to lend legitimacy to its members while requiring very little of them.^{1045 1046}

Zoos source the vast majority of their animals from other zoos and captive breeders. Animals may be transported or housed with other animals of the same or different species, and throughout their lives, interact closely with their human keepers. Zookeepers are responsible for a range of animal care activities from feeding to cleaning cages to handling and transporting animals, each of which offer opportunities for zoonotic disease transmission. In addition, animals may interact with other species of captive wildlife as well as free-roaming animals such as wild birds. Zookeepers, equipment, and other resources may be shared among different species and exhibitions, increasing the potential for interspecies spread. Unwanted zoo animals are sometimes sold to other zoos or sold to private individuals, captive hunting ranches, or are, on occasion, killed.^{1047 1048 1049 1050}

1042. Wayne Pacelle, "HSUS, Top Zoos Can Together Be a Force for Good," *Humane Society of the United States*, September 11, 2017, <https://blog.humanesociety.org/2017/09/hsus-top-zoos-force-for-good.html>.
 1043. "Accreditation FAQs," *Association of Zoos and Aquariums*, accessed May 15, 2023, <https://www.aza.org/accred-faq>.
 1044. "AZA vs ZAA," *Big Cat Rescue*, March 11, 2022, <https://bigcatrescue.org/aza-vs-zaa/>.
 1045. Alissa Widman Neese, "Scoop: Zoo Seeks New Accreditation, But Not Without Critics," *Axios Columbus*, April 18, 2022, <https://www.axios.com/local/columbus/2022/04/18/columbus-zoo-seeks-new-accreditation-zaa-criticism>.
 1046. "AZA vs ZAA," *Big Cat Rescue*, March 11, 2022, <https://bigcatrescue.org/aza-vs-zaa/>.
 1047. *The Conservation Game*, directed by Michael Webber (Nightfly Entertainment, 2021), <https://www.theconservationgame.com/watch/>.
 1048. "'Joe Exotic' Sentenced to 22 Years for Murder-For-Hire and for Violating the Lacey Act and Endangered Species Act," *U.S. Attorney's Office*, Western District of Oklahoma, January 22, 2020, <https://www.justice.gov/usao-wdok/pr/joe-exotic-sentenced-22-years-murder-hire-and-violating-lacey-act-and-endangered>.
 1049. Jennifer Smola Shaffer and Alissa Widman Neese, "Conservation Game Documentary Ties Columbus Zoo, Jack Hanna to Unchecked Big Cat Trade," *The Columbus Dispatch*, August 18, 2021, <https://www.dispatch.com/story/news/local/2021/08/17/first-look-conservation-game-documentary/8149879002/>.
 1050. Amy Wallace, "San Diego Zoo Halts Sales to Breeders Tied to Hunting: Animal rights: Embarrassed Zoo Official Says the Dealers' Links to Hunting Were Not Known," *Los Angeles Times*, September 18, 1991, <https://www.latimes.com/archives/la-xpm-1991-09-18-mn-2163-story.html>.

While the range of potential zoonotic diseases that may be carried by zoo animals is seemingly infinite, the overall risk of transmission is relatively low at institutions accredited by the Association of Zoos and Aquariums, and largely limited to zookeepers, as long as the public is not allowed to interact with the animals directly.¹⁰⁵¹ Zoos that are not accredited by the Association of Zoos and Aquariums,

however, (including facilities that are accredited by the Zoological Association of America), present a significantly higher risk of transmission because they often allow direct interaction between the public and animals, generally have poorer conditions and animal care, and offer more limited veterinary oversight.¹⁰⁵² ¹⁰⁵³ Many Zoological Association of America facilities have logged dozens of Animal Welfare Act violations without losing their associated accreditation.¹⁰⁵⁴ Indeed, there is no record of any Zoological Association of America institution ever losing this accreditation for any reason.¹⁰⁵⁵

Recent outbreaks of COVID-19 among captive guerrillas, snow leopards, and other zoo animals make clear the risk of reverse zoonotic transmission (from humans to animals) at zoo facilities.¹⁰⁵⁶ Transmitting a virus from humans to animals can allow it opportunities to change and develop new forms that may then be transmitted back to humans. This risk may be particularly great in zoos where humans interact closely with a vast range of different wildlife species over prolonged periods of time.

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35. Marine Animal Parks

Marine animal parks are commercial operations where aquatic species including marine mammals such as dolphins, beluga whales, seals, and sea lions are kept and displayed to the public through exhibits and shows.¹⁰⁵⁷ SeaWorld, SeaLife Park Hawaii, Marineland of Florida, Discovery Cove, Miami Seaquarium, and Six Flags Discovery are examples of major marine animal parks in the United States.¹⁰⁵⁸ Other marine parks such as the Dolphin Research Center employ captive ocean pens to the

1051. Still, outbreaks do occur. For example, eight zookeepers and volunteers became infected with tuberculosis from elephants in one such event at the Oregon Zoo. Lynne Terry, "Oregon Zoo Staff Infected by Tuberculosis After Exposure to Infected Elephants," *The Oregonian*, January 8, 2016, https://www.oregonlive.com/health/2016/01/officials_identify_tuberculosis.html.

1052. These risks may be amplified by improper disposal of deceased animals, with reports of zookeepers killing animals through improper methods such as drowning and disposing of animals in open garbage bins. Justin Jouvenal, "Mauling, Escapes and Abuse: 6 Small Zoos, 80 Sick or Dead Animals," *The Washington Post*, September 18, 2015, https://www.washingtonpost.com/local/crime/mauling-escapes-and-abuse-6-small-zoos-80-sick-or-dead-animals/2015/09/18/dff46f10-2581-11e5-b77f-eb13a215f593_story.html.

1053. In addition, ZAA facilities, unlike AZA zoos, support private ownership of exotic animals.

1054. Rebecca L. Jodidio, "The Animal Welfare Act is Lacking: how to Update the Federal Statute to Improve Zoo Animal Welfare," *Golden Gate University Environmental Law Journal* 12, No. 1 (July 2020): <https://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1155&context=gguelj>.

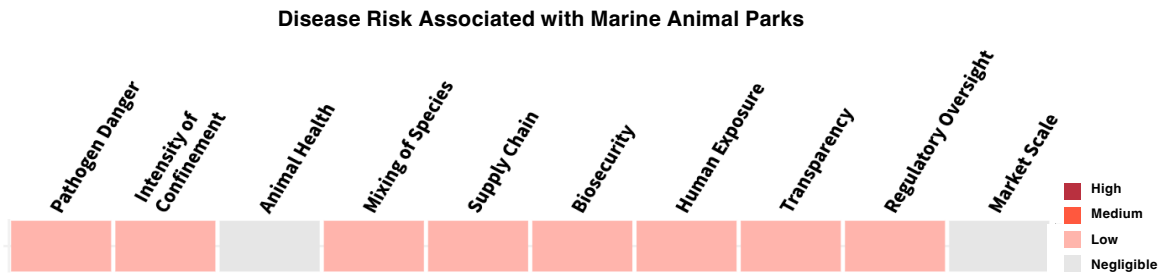
1055. Alissa Widman Neese, "Scoop: Zoo Seeks New Accreditation, But Not Without Critics," *Axios Columbus*, April 18, 2022, <https://www.axios.com/local/columbus/2022/04/18/columbus-zoo-seeks-new-accreditation-zaa-criticism>.

1056. Edward Helmore, "Snow Leopard at Illinois Zoo Dies After Contracting Covid-19," *The Guardian*, January 8, 2022, <https://www.theguardian.com/us-news/2022/jan/08/snow-leopard-dies-covid-19-illinois-zoo>.

1057. Marine mammal parks are different from marine parks, which include natural reserves and marine wildlife sanctuaries such as coral reefs.

1058. See <https://seaworld.com>, <https://www.sealifeparkhawaii.com>, <https://marineland.net>, <https://discoverycove.com/orlando/>, <https://www.sixflags.com/discoverykingdom>, accessed May 4, 2021.

same effect.¹⁰⁵⁹ Activities at these parks often include petting marine animals in touch tanks, ‘feed the dolphins’ exhibits where visitors purchase squid to feed to dolphins by hand, as well as other ‘encounter’-style activities that allow visitors to touch and swim with sea lions or dolphins.¹⁰⁶⁰



Stress and poor conditions undermine animal health, weakening their immune systems and increasing mortality rates.¹⁰⁶¹ Records show that a quarter of the sea lions, seals, dolphins, and whales kept in U.S. marine parks die before they reach the age of one; half die before they reach age seven.¹⁰⁶² However, while these facilities may raise serious animal welfare concerns, especially with regard to marine mammals, zoonotic disease risk at marine animal parks is relatively low and generally limited to localized skin infections. In some cases, touch tanks and infected water can facilitate the spread of pathogens.¹⁰⁶⁴ More dangerous infections can also occur including brucellosis, tuberculosis, calicivirus, and influenza A.¹⁰⁶⁶ Employees who work at these facilities are typically at the greatest risk. For example, roughly 11% of marine mammal workers report having contracted a bacterial infection, colloquially known as “seal finger.”¹⁰⁶⁷ ¹⁰⁶⁸

The Marine Mammal Protection Act allows dolphins and other marine animals to be captured from the wild for public display with certain conditions.¹⁰⁶⁹ National Oceanic and Atmospheric Administration (NOAA), the administrative agency that enforces the Marine Mammal Protection Act, issues permits for wild capture of marine mammals but does not require marine



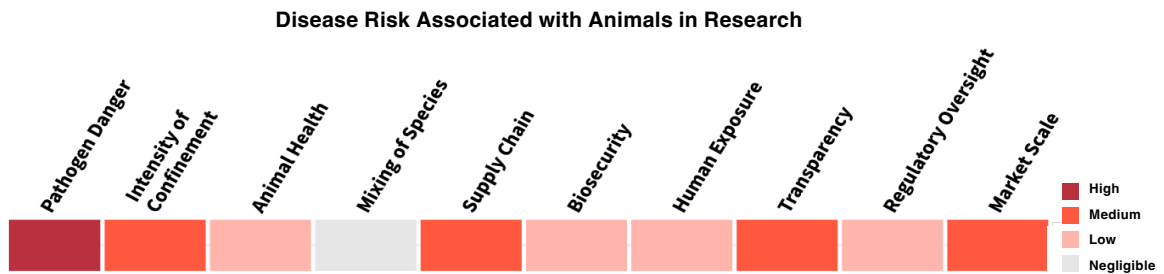
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1059. Dolphin Research Center Website, accessed May 9, 2023, <https://dolphins.org/>.
 1060. See <https://seaworld.com>, <https://www.sealifeparkhawaii.com>, <https://marineland.net>, <https://discoverycove.com/orlando/>, <https://www.sixflags.com/discoverykingdom>, accessed May 4, 2021.
 1061. Patricia A. Fair and Paul R. Becker, “Review of Stress in Marine Mammals,” *Journal of Aquatic Ecosystem Stress and Recovery* 7 (October 2000): 335-354, <https://doi.org/10.1023/A:1009968113079>.
 1062. The average lifespan of a sea lion living in the wild is 15-20 years. Dolphins and whales in the wild typically live 30-50 years. “Wildlife Fact Sheets,” *Ocean Conservancy*, accessed May 31, 2023, <https://oceanconservancy.org/wildlife-factsheet/california-sea-lion/>.
 1063. Sally Kestin, “Not a Perfect Picture,” *South Florida Sun Sentinel*, May 16, 2004, <https://www.sun-sentinel.com/news/fl-xpm-2004-05-16-0405160047-story.html>.
 1064. Barbara Johnson and Joseph Mat Schech, “Animal Bytes,” *Applied Biosafety* 19, No. 4 (2014): <https://www.liebertpub.com/doi/epdf/10.1177/153567601401900409>.
 1065. M. Weir, A. Rajic, L. Dutil, N. Cernicchiaro, et al., “Zoonotic Bacteria, Antimicrobial Use and Antimicrobial Resistance in Ornamental Fish: A Systematic Review of the Existing Research and Survey of Aquaculture-Allied Professionals,” *Epidemiology and Infection* 140, No. 2 (September 2011): 192-206, <https://doi.org/10.1017/S0950268811001798>.
 1066. T. B. Waltzek, G. Cortés-Hinojosa, J. F. X. Wellehan Jr., and Gregory C. Gray, “Marine Mammal Zoonoses: A Review of Disease Manifestations,” *Zoonoses and Public Health* 59, No. 8 (December 2012): 521-535, <https://doi.org/10.1111/j.1863-2378.2012.01492.x>.
 1067. Naomi A. Rose, E.C.M. Parsons, and Richard Farinato, “The Case Against Marine Mammals in Captivity,” 5th edition (Washington, DC: Animal Welfare Institute and World Animal Protection, 2019), <https://awionline.org/sites/default/files/uploads/documents/AWI-ML-CAMMIC-5th-edition.pdf>.
 1068. Tania D. Hunt, Michael H Ziccardi, Frances Gulland, and Pamela K Yochem, “Health Risks for Marine Mammal Workers,” *Diseases of Aquatic Org. anisms* 81, No. 1 (September 2008): 81-92, <https://doi.org/10.3354/dao01942>.
 1069. “Public Display of Marine Mammals,” *National Oceanic and Atmospheric Administration*, last modified April 3, 2023, <https://www.fisheries.noaa.gov/national/marine-mammal-protection/public-display-marine-mammals>.

animal parks to obtain a permit in order to operate.¹⁰⁷⁰ As a result, the only on-site regulation of marine animal parks themselves is carried out by the USDA via the Animal Welfare Act.

36. Animals in Research

Millions of animals are imported to U.S. laboratories every year to be used for one of three purposes: biomedical research (testing drugs and vaccines), testing consumer products (primarily cosmetics and cleaners), and education (medical and veterinary learning exercises).^{1071 1072 1073} Millions more are bred domestically for these same purposes.¹⁰⁷⁴ Some of the species most commonly used in research include mice, rats, rabbits, pigs, guinea pigs, hamsters, dogs, and non-human primates.^{1075 1076}



In 2018, the USDA reported that 780,070 animals were used in research facilities in the United States.¹⁰⁷⁷ However, this figure reflects only those species covered by the Animal Welfare Act. Mice, rats,

fish, amphibians, reptiles, cephalopods, birds, and other animals are not included in this number. Studies suggest that between 93%-99% of the animals used in research are excluded from the protections of the AWA, which regulates only a small fraction of the estimated 11 million animals housed in research facilities around the United States.^{1078 1079} While historically sourcing animals for research purposes has been a matter of public concern, today most

Between 93%-99% of the animals used in research are excluded from the protections of the AWA.

1070. "Public Display of Marine Mammals," *National Oceanic and Atmospheric Administration*, last modified April 3, 2023, <https://www.fisheries.noaa.gov/national/marine-mammal-protection/public-display-marine-mammals>.

1071. David Grimm, "How Many Mice and Rats are Used in U.S. Labs? Controversial Study Says More than 100 Million," *Science*, January 12, 2021, <https://www.science.org/content/article/how-many-mice-and-rats-are-used-us-labs-controversial-study-says-more-100-million>.

1072. "Animal Testing and Research Achievements," *Foundation for Biomedical Research*, accessed May 31, 2023, <https://fbresearch.org/medical-advances/animal-research-achievements/>.

1073. Renee M. McFee, Andrea S. Cupp, and Jennifer R. Wood, "Use of Case-Based or Hands-On Laboratory Exercises with Physiology Lectures Improves Knowledge Retention, But Veterinary Medicine Students Prefer Case-Based Activities," *Advances In Physiology Education* 42, No. 2 (June 2018): 182-191, <https://doi.org/10.1152/advan.00084.2017>.

1074. David Grimm, "How Many Mice and Rats Are Used in U.S. Labs? Controversial Study Says More Than 100 Million," *Science*, January 12, 2021, <https://www.science.org/content/article/how-many-mice-and-rats-are-used-us-labs-controversial-study-says-more-100-million>.

1075. "Animal Testing and Experiments FAQ," *Humane Society of the United States*, accessed May 31, 2023, <https://www.humanesociety.org/resources/animals-used-experiments-faq>.

1076. "Animals in Science: Which Animals Are Used," *American Anti-Vivisection Society*, accessed May 31, 2023, <https://aavs.org/animals-science/animals-used/>.

1077. This number includes 122,717 animals held but not used in research. "Annual Report Animal Usage by Fiscal Year Fiscal Year 2018," *USDA Animal and Plant Health Inspection Service*, accessed May 31, 2023, <https://speakingofresearch.files.wordpress.com/2020/01/usda-annual-report-animal-usage-in-research-2018.pdf>.

1078. "Annual Statistics of Scientific Procedures on Living Animals, Great Britain 2018," House of Commons HC 2475, July 18, 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835935/annual-statistics-scientific-procedures-living-animals-2018.pdf.

1079. This estimate of 11 million includes only vertebrate animals. Other research offers a more conservative estimate. For example, if numbers reported from the EU are representative of US practices as well, 93% of research is conducted on species not counted under the Animal Welfare Act, the total number of vertebrates used in research in the United States would be approximately 11 million. "2019 Report on the Statistics on the Use of Animals for Scientific Purposes in the Member States of the European Union in 2015-2017," *Report from the Commission to the European Parliament and the Council*, May 2, 2020, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1581689520921&uri=CELEX:52020DC0016>.

research animals that fall under USDA oversight are bred or sourced by licensed dealers as mandated by the AWA rather than through random source providers.^{1080 1081} However, this does not extend to the majority of research animals, who are excluded from the Act's coverage. In addition to the AWA, animals used in federally funded research may be subject to additional oversight from the National Institute of Health (NIH).



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Perhaps in part due to the fact that animals are often kept in isolation and in part due to self-imposed protocols, instances of zoonotic disease outbreaks among animals appear quite rare in research facilities. However, the importation of wild species in particular carries exposure risk. For example, in a well-known incident from 1989, 100 monkeys who were imported by the Hazelton Research Products facility in Reston, Virginia carried a new strain of Ebola virus and infected several research workers at the facility.¹⁰⁸²

Additionally, several biosecurity labs in the United States carry out research focused on infectious disease wherein animals are deliberately infected or exposed to dangerous pathogens. Some of these studies have led to exposure among laboratory workers who then risk spreading these diseases to the general public.¹⁰⁸³ The CDC requires safety protocols commensurate with pathogen risk as labs are rated from biosecurity level one to biosecurity level four (BSL-1 to BSL-4). Many of the most dangerous zoonotic pathogens may only be handled at one of a handful of BSL-4 facilities in the United States. Perhaps the most controversial type of research study is “gain of function research,” which seeks to better understand how pathogens, often animal pathogens, could be altered and made to adapt and acquire new capacities such as becoming more virulent, more transmissible, or better able to infect new hosts, often for the purposes of defending against them.¹⁰⁸⁴

Research animal transactions are regulated primarily at the federal level, but more often, they are managed through voluntary standards. The USDA administers the Animal Welfare Act's registration requirements.¹⁰⁸⁵ The USDA is also required to annually inspect each of the 1,100 or more research facilities in the United States for basic standards of veterinary care and animal husbandry including proper housing, treatment, food, and water. However, recent Freedom of Information Act filings show that since at least 2019, the USDA has

Research animal transactions are regulated primarily at the federal level, but more often, they are managed through voluntary standards.

1080. “Licensing and Registration Under the Animal Welfare Act. Animal and Plant Health Inspection Service,” *USDA Program Aid*, No. 1117, last modified February 2019, <https://naldc.nal.usda.gov/catalog/7257529>.

1081. Arianna Pittman, “Pet Stores Aren't the Only Issue—How Research Labs Also Fuel the Commercial Breeding Industry,” *One Green Planet*, April 2021, <https://www.onegreenplanet.org/animalsandnature/research-labs-fuel-commercial-breeding-industry/>.

1082. This strain of Ebola virus, unlike prior strains, proved non-pathogenic in humans. These same monkeys were also infected with Simian hemorrhagic fever virus. P.B. Jahrling, T.W. Geisbert, E.D. Johnson, C.J. Peters, et al., “Preliminary Report: Isolation of Ebola Virus from Monkeys Imported to USA” *The Lancet* 335, No. 8688 (1990): 502, [https://doi.org/10.1016/0140-6736\(90\)90737-P](https://doi.org/10.1016/0140-6736(90)90737-P).

1083. David Willman and Madison Muller, “A Science in the Shadows,” *The Washington Post*, August 26, 2021, <https://www.washingtonpost.com/nation/interactive/2021/a-science-in-the-shadows/>.

1084. Amber Dance, “The Shifting Sands of ‘Gain-of-Function’ Research,” *Nature*, October 27, 2021, <https://www.nature.com/articles/d41586-021-02903-x>.

1085. Research facilities are required to be registered but not licensed under the AWA. This is a critical distinction from other types of AWA-regulated facilities, with significant repercussions including that the USDA cannot take away their ability to operate. “Apply for a License or Registration,” *USDA Animal and Plant Health Inspection Service*, last updated April 13, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/apply/licensing-and-registration-application-packets>.

been pursuing a confidential policy of not fully inspecting certain facilities, deferring that work instead to a private organization, AAALAC International, despite the agency's public assurances that all facilities were personally inspected by USDA inspectors.^{1086 1087} Voluntary guidelines or certification are offered by the Improved Standards for Laboratory Animals Act, a 1985 amendment of the Animal Welfare Act, the Public Health Service (PHS) Policy on the Humane Care and Use of Laboratory Animals, and the industry guiding principles of the 3 R's—replace, reduce, and refine—that have long been a mantra to guide responsible use in animal testing.¹⁰⁸⁸ With the exception of AWA registration and regulation, however, all of these guidelines are voluntary for many research institutions.¹⁰⁸⁹



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Research animal suppliers are required to be licensed, unlike research facilities themselves, which must only be registered.¹⁰⁹⁰ Competition among research animal suppliers has pushed the industry to become more commercialized in recent years. In order to maintain their contracts with research labs, breeders typically subscribe to heightened veterinary, housing, and general care protocols, all of which may reduce the likelihood of disease, but this is not true across the board.¹⁰⁹¹ For example, one chinchilla breeding facility supplying animals to research labs was recently cited for more than 100 alleged animal welfare violations between 2013 and 2017.¹⁰⁹² More than 80 of these violations were driven by the lack of veterinary care supplied to sick and injured animals, as well as extremely poor living conditions, all of which foster disease transmission.¹⁰⁹³

1086. David Grimm, "USDA Now Only Partially Inspects Some Lab Animal Facilities, Internal Documents Reveal," *Science*, May 5, 2021, <https://www.sciencemag.org/news/2021/05/usda-now-only-partially-inspects-some-lab-animal-facilities-internal-documents-reveal>.

1087. Rachel Reed, "They're Lying to the Public," *Harvard Law Today*, June 4, 2021, <https://today.law.harvard.edu/theyre-lying-to-the-public/>.

1088. W. M. S. Russell and R. L. Burch, *The Principles of Humane Experimental Technique* (London: Methuen, 1959).

1089. Research facilities that received Public Health Service funds must follow the Public Health Service Policy on Humane Care and Use of Laboratory Animals, and establish an Institutional Animal Care and Use Committee to review and approve all proposed research. "Regulation of Animal Research," in *Science, Medicine, and Animals* (Washington DC: National Academies Press, 2004).

1090. "Regulation of Animal Research," in *Science, Medicine, and Animals* (Washington DC: National Academies Press, 2004).

1091. National Research Council, *Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research* (Washington DC: National Academies Press, 2009).

1092. A chinchilla is a small South American rodent often used to study hearing loss.

1093. Dina Fine Maron, "Major U.S. Chinchilla Supplier Heads to Court With More than 100 Animal Welfare Violations," *National Geographic*, July 28, 2021, <https://www.nationalgeographic.com/animals/article/major-chinchilla-supplier-heads-to-court-with-more-than-100-animal-welfare-violations>.



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POLICY THEMES AND CHALLENGES

In the above sections we seek to analyze the risks presented by animal markets in the United States, though there are many variables involved and estimating these risks is not a precise science. In this section, we turn to the question of how the regulatory system manages or fails to manage those risks. In doing so, we move from the specific to the general to describe the regulatory landscape writ large.

Over the course of our research, we observed patterns and problems that characterize the U.S. policy response to animal markets, some of which are highlighted below in greater depth. Often these issues affect more than one of the markets mentioned above and speak to the role of institutional actors such as federal and state agencies. Taken together, they reveal the lack of a coordinated approach to addressing zoonotic disease. These challenges culminate in a system in which regulation is not always proportional to risk. The resultant landscape is one of confusion and legal gray areas, marked by underregulation and, in some cases, outright regulatory voids.

Disease risk in the United States could be radically reduced through policies that are based on a clear understanding of the markets as detailed in this study, through laws and regulations that are proportionate to risk, and through adequate implementation and enforcement. The following discussion is meant to lay the groundwork for such change by documenting the pitfalls and challenges that characterize the current U.S. regulatory response. Shining a light on these blindspots is a first step toward addressing them.

These policy challenges are loosely organized into three categories: Foundation, Design, and Function. “Foundational” challenges are those inherent to the subject matter that make the space particularly hard to regulate. By contrast, “Design” is used to describe challenges that arise from institutional, legislative, or regulatory design. Finally, “Function” captures challenges stemming from application—in particular, the ways in which agencies operate and how regulation is carried out.

It should be noted that these are not bright line categories—they often bleed into one another, as any such categorization is artificial and inherently messy. As a result, several of the themes identified below straddle the line between two or more of these categories. By and large, those challenges that touch upon multiple categories are among the stickiest problems and the most difficult to address.

Foundation

This group of insights describe unique foundational challenges that make the space particularly hard to regulate. They seek to answer questions such as: What makes animals and disease different from other regulatory subjects? What about those differences makes regulation more challenging?

Artificial Classifications and Assignments

Animals are often classified into artificially defined categories such as “wildlife,” “livestock,” or “companion animals” based on human use. Generally speaking, regulatory responsibility for each type of animal is divided along similar lines. The USDA primarily governs species considered “livestock” while FWS oversees “wildlife,” for example. However, these categories are inherently arbitrary and anthropocentric. They say more about humans than they do about animals. Furthermore, they oversimplify the wide spectrum of species and animal use. As a result, these classifications carry little meaning from a biological perspective as pathogens transcend these boundaries, passing easily from one category of animal to the next. To apply these same classifications to disease (treating them as “livestock diseases” or “wildlife diseases,” for example) belies a fundamental misunderstanding of the way pathogens operate and hinders our ability to contain them.¹⁰⁹⁴

Too often, the result is a fractured response whereby different agencies apply incomplete strategies and narrowly circumscribe their own role in disease prevention. For example, the USDA may see some “wildlife diseases” as irrelevant or outside its responsibility, despite the fact that many such diseases may spread from “wildlife” to “livestock.” One research study documenting this paradox found that although the USDA regulators and state department of agriculture officials interviewed for the study regarded “wildlife” as the dominant source of most zoonotic diseases impacting humans and livestock, they had no working relationship with state or federal wildlife agencies. The author noted, “The gap between these two worlds seemed even wider than the gap between [livestock] and public health.”¹⁰⁹⁵

Furthermore, classifications of animals are not uniform or consistent between jurisdictions. The regulatory status of animals can vary from one state to the next. In the case of the exotic pet trade, captive hunting, or big game farming, for example, species are treated differently across state lines such that the same animal may fall under the department of agriculture in one state and the department of wildlife in another and be completely unregulated in the next. These discrepancies, both with respect to what activities are regulated and



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1094. Colin Jerolmack, “Who’s Worried About Turkeys? How ‘Organisational Silos’ Impede Zoonotic Disease Surveillance,” *Sociology of Health & Illness* 35, No. 2 (February 2013): 200-212, <https://doi.org/10.1111/j.1467-9566.2012.01501.x>.

1095. Colin Jerolmack, “Who’s Worried About Turkeys? How ‘Organisational Silos’ Impede Zoonotic Disease Surveillance,” *Sociology of Health & Illness* 35, No. 2 (February 2013): 200-212, <https://doi.org/10.1111/j.1467-9566.2012.01501.x>.

by whom, result in confusion within and across states, and undermine the effectiveness of the regulatory system as a whole. These problems are exacerbated by the fact that wild animals, and indeed pathogens themselves, do not respect human borders.

Interconnectedness and Interplay Between Industries

To further complicate matters, many animals change use as they move through multiple markets across intermixed supply chains. A change in use is often accompanied by a change in legal status. For example, a kangaroo at a zoo may be sold directly to a captive hunting operation and in the process change legal status from captive wildlife to livestock.

These transitions complicate regulatory enforcement and carry public health implications as well. A single animal may change hands dozens of times across multiple states and sellers with little or no documentation, while at the same time changing legal status. Should a disease outbreak occur, officials have no clear means of containment or traceable records to follow. For example, during the 2003 mpox outbreak, the CDC was able to locate less than half of the animals from the infected shipment of prairie dogs that spawned the outbreak. More than a hundred disappeared without record, presumably sold to families through swap meets, pet stores, and flea market sales.¹⁰⁹⁶ This movement can occur even within supply chains that appear self-contained. For instance, one interviewee discussed obtaining a Japanese snow macaque through the exotic pet trade that was branded with a tattoo indicating that the primate had previously been used in research.¹⁰⁹⁷

In addition, legal and illegal trade in animals are often intertwined. There are many instances in which the same actors engage in both legal and illegal sales. For example, swap meet vendors may trade in legal species inside the venue and, at the same time, traffic in protected ones outside in the parking lot.¹⁰⁹⁸ The interconnectedness of animal supply chains makes regulating them more difficult. The legal status of the animal is not fixed but instead can be in flux as the animal moves through different markets, leading to regulation that varies over time and across the value chain.

In addition, the interplay between different forms of animal industry can heighten the risk of zoonotic disease emergence. For example, geographic proximity between poultry and swine production may increase the risk of generating a form of influenza virus that can infect humans.¹⁰⁹⁹ Pigs, who are susceptible to both avian and human influenza strains, can serve as mixing vessels to create new viruses—combining avian, human, and swine influenza viruses—or by taking avian viruses “allow them to adapt and efficiently infect mammals.”¹¹⁰⁰ Housing 8,000 pigs just a few hundred yards from an operation

The legal status of the animal is not fixed but instead can be in flux as the animal moves through different markets, leading to regulation that varies over time and across the value chain.

1096. “Update: Multistate Outbreak of Monkeypox—Illinois, Indiana, Kansas, Missouri, Ohio, and Wisconsin, 2003,” *CDC MMWR Weekly*, July 11, 2003, 52(27): 642-646, <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5227a5.htm>.

1097. Personal interview with retired Ohio police officer and expert on exotic pets and large cats, May 18, 2021.

1098. Alternatively, in some cases, selling the same animal intrastate may be legal while selling that animal interstate is not.

1099. Jessica H. Leibler, Joachim Otte, David Roland-Holst, Dirk U. Pfeiffer, et al., “Industrial Food Animal Production and Global Health Risks: Exploring the Ecosystems and Economics of Avian Influenza,” *EcoHealth*, 6 (2009): 58-70, <https://doi.org/10.1007/s10393-009-0226-0>.

1100. Amy L. Vincent, Marie R. Culhane, Christopher W. Olsen, “Influenza: Pigs, People & Public Health,” *National Pork Board*, Doc. #04726, June 2018, https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/swine/mpbis-influenza-pigs-people.pdf.



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keeping 100,000 chickens can allow for significant cross contamination between the two groups of animals, as can transporting animals to and from facilities.¹¹⁰¹ The high-volume fans needed to ventilate pig and poultry facilities can add to this risk, spreading particles and pathogens in both directions.¹¹⁰²

Over the last 60 years, production of both pigs and poultry has become increasingly clustered, concentrating in regions of the Midwest and Southeast and overlapping in areas like Iowa and North Carolina.^{1103 1104} In these places, each form of production makes the other more dangerous. One study done in Minnesota, for example, found that turkey farms within 2 kilometers of pig facilities had eight times higher odds of influenza infection than farms that were located between 4-6 kilometers from the nearest pig facility.¹¹⁰⁵ And while USDA factsheets warn, “Do not raise pigs and domestic fowl on the same premises,” many producers do just that.^{1106 1107} Though both USDA and CDC are well versed in the risks, neither imposes any regulation to separate pig and poultry operations in order to prevent the creation of new influenza viruses.

However, the interplay between different animal industries can amplify risk in other ways as well. For example, pathogens can spread as animals produced in one industry are used to feed animals in another. In an outbreak of influenza outbreak among 15,000 mink held on a Midwestern fur farm, researchers determined that the animals likely became infected when they were fed raw or partially-cooked turkey meat from birds who were carrying the virus.¹¹⁰⁸ However, laboratory analysis suggested that the strain the mink were infected with originated in swine—likely moving from a pig facility to infect nearby turkeys before the birds were slaughtered and fed to captive mink.¹¹⁰⁹ In this way, the connections and movement between different forms of animal use can increase the risk of disease spread and spillover.

Invisibility of Animal Markets

Policymakers cannot regulate what they cannot see. Yet some of the highest-risk animal markets in the United States are largely invisible to

Policymakers cannot regulate what they cannot see.

1101. Jessica H. Leibler, Joachim Otte, David Roland-Holst, Dirk U. Pfeiffer, et al., “Industrial Food Animal Production and Global Health Risks: Exploring the Ecosystems and Economics of Avian Influenza,” *EcoHealth*, 6 (2009): 58-70, <https://doi.org/10.1007/s10393-009-0226-0>.
1102. Jessica H. Leibler, Joachim Otte, David Roland-Holst, Dirk U. Pfeiffer, et al., “Industrial Food Animal Production and Global Health Risks: Exploring the Ecosystems and Economics of Avian Influenza,” *EcoHealth*, 6 (2009): 58-70, <https://doi.org/10.1007/s10393-009-0226-0>.
1103. Jessica H. Leibler, Joachim Otte, David Roland-Holst, Dirk U. Pfeiffer, et al., “Industrial Food Animal Production and Global Health Risks: Exploring the Ecosystems and Economics of Avian Influenza,” *EcoHealth*, 6 (2009): 58-70, <https://doi.org/10.1007/s10393-009-0226-0>.
1104. Gary Benjamin, “Industrialization in Hog Production: Implications for Midwest Agriculture,” *Economic Perspectives, Federal Reserve Bank of Chicago*, <https://www.chicagofed.org/~media/publications/economic-perspectives/1997/epjf97a-pdf.pdf>.
1105. Cesar A. Corzo, Marie Gramer, Dale Lauer, Peter R. Davies, “Prevalence and Risk Factors for H1N1 and H3N2 Influenza A Virus Infections in Minnesota Turkey Premises,” *Avian Diseases* 56, No. 3 (2012): 488-493, <https://doi.org/10.1637/10037-121211-Reg.1>.
1106. Amy L. Vincent, Marie R. Culhane, Christopher W. Olsen, “Influenza: Pigs, People & Public Health,” National Pork Board, Doc. #04726, June 2018, https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/swine/npbfs-influenza-pigs-people.pdf.
1107. For example, a farm in Ohio raising both turkeys and pigs in buildings just twelve meters apart saw two influenza outbreaks affecting both species in consecutive years. Cesar A. Corzo, Marie Gramer, Dale Lauer and Peter R. Davies, “Prevalence and Risk Factors for H1N1 and H3N2 Influenza A Virus Infections in Minnesota Turkey Premises,” *Avian Diseases* 56, No. 3 (2012): 488-493, <https://doi.org/10.1637/10037-121211-Reg.1>.
1108. Kyoung-Jin Yoon, Kent Schwartz, Dong Sun, Jianqiang Zhang, Hugh Hildebrandt, “Naturally Occurring Influenza A Virus Subtype H1N2 Infection in a Midwest United States Mink (*Mustela vison*) Ranch,” *Journal of Veterinary Diagnostic Investigation* 24, No. 2 (2012): 388-391, doi: 10.1177/1040638711428349.
1109. Kyoung-Jin Yoon, Kent Schwartz, Dong Sun, Jianqiang Zhang, Hugh Hildebrandt, “Naturally Occurring Influenza A Virus Subtype H1N2 Infection in a Midwest United States Mink (*Mustela vison*) Ranch,” *Journal of Veterinary Diagnostic Investigation* 24, No. 2 (2012): 388-391, doi: 10.1177/1040638711428349.

the general public, regulators, or, in some cases, both. Evidence-based policy and decision-making must be grounded in data, but right now agencies lack even basic information about where, how, and why human-animal interactions are driving zoonotic risk. Agency representatives we spoke to sometimes expressed surprise to learn about the existence, extent, or practices of some of the less-visible markets cataloged here. “I am most concerned with those in-between spaces,” one CDC official told us—in particular, non-traditional farmed species. “So many of these areas fall into potential gaps in current regulation.”¹¹¹⁰ Niche industries such as ferret farming, coyote urine production, and other forms of captive wildlife breeding operate almost completely out of sight apart from a small network of participating individuals, but these industries too may carry serious risk.

Even large markets can go mostly unnoticed by regulators. Exotic pets, for example, are sometimes known as the “animals in our basements” because they are typically held outside the view of neighbors, policymakers, and law enforcement, but together these animals constitute a \$15 billion dollar industry comprising an estimated 113 million animals.^{1111 1112} States lack basic information about how many and what kinds of animals are held inside their borders. When COVID-19 outbreaks ravaged Wisconsin fur farms and elsewhere, in Michigan, spilled back from mink to infect humans, state public health officials had to ask for help from a fur industry trade group to find out how many farms there were in Wisconsin and where they were located. The state had no access to this information nor any means to contact operators.^{1113 1114 1115 1116} There is virtually no data or monitoring of the exotic pet trade, fur farming, or many other high-risk animal markets.

And yet, some of these unregulated, unseen industries are among the most dangerous. Mink farms spawned the creation of new variants of SARS-CoV-2, infecting mink farmers and threatening new outbreaks.¹¹¹⁷ In addition, in 2022, 50,000 mink at a fur farm in Spain were destroyed after the animals became infected with H5N1 influenza, setting off fears of a new human pandemic.¹¹¹⁸ And although entering a poultry facility, for example, often requires visitors and workers to wear a full Tyvek suit, mask, booties, and to “shower in”

Niche industries operate almost completely out of sight apart from a small network of participating individuals, but these industries too may carry serious risk.

There is virtually no data or monitoring of the exotic pet trade, fur farming, or many other high-risk animal markets.

1110. Member of National Center for Emerging and Zoonotic Infectious Diseases, CDC, background interview, September 1, 2021.

1111. “U.S. Pet Ownership Statistics,” *American Veterinary Medical Association*, accessed May 17, 2023, <https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics#exotic>.

1112. Estimating the value of the exotic pet trade in the United States is very hard due to widespread lack of tracking. Jessica Kim, “How Big Is the Exotic Pet Trade?” *PetKeen*, last updated May 13, 2023.

1113. Kate Golden, “The Wild World of Mink and Coronavirus,” *Sierra Magazine*, January 7, 2021, <https://www.sierraclub.org/sierra/wild-world-mink-and-coronavirus>.

1114. Bas B. Oude Munnink, Reina Sikkema, David F. Nieuwenhuis, Robert Jan Molenaar, et al., “Transmission of SARS-CoV-2 on Mink Farms Between Humans and Mink and Back to Humans,” *Nature* 371, No. 6525 (November 10, 2020): 172-177, doi: 10.1126/science.abe5901.

1115. “Animals and COVID-19,” *Centers for Disease Control and Prevention*, last updated April 7, 2023, <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/animals.html>.

1116. Emily Anthes, “Four Americans Were Infected With a Virus Variant Seen in Mink,” *The New York Times*, April 18, 2022, <https://www.nytimes.com/2022/04/18/health/covid-mink-michigan.html>.

1117. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

1118. Kai Kupferschmidt, “Incredibly Concerning: Bird Flu Outbreak at Spanish Mink Farm Triggers Pandemic Fears,” *Science*, January 24, 2023, <https://www.science.org/content/article/incredibly-concerning-bird-flu-outbreak-spanish-mink-farm-triggers-pandemic-fears>.

and “out” of the facility, mink farms generally take no such precautions and lack even basic biosecurity measures.^{1119 1120} In researching a piece on viral spillback of disease from humans to animals, a reporter for the *New York Times* interviewed mink workers in 2021, who were wearing no masks and flip-flops, standing between “ridges of mink waste” with animals in “rows of wire cages stacked waist high.”¹¹²¹ But

Many industries—from livestock auctions, to swap meets, to roadside zoos— have taken steps to maintain some level of secrecy by limiting access to journalists, prohibiting photography, and, in the case of industrial animal agriculture, lobbying to criminalize such actions.



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because fur farms fall in a regulatory blindspot, neither the USDA nor USFWS tracks these operations—both claiming that these captive wildlife farms fall outside their jurisdiction.

Many industries—from livestock auctions, to swap meets, to roadside zoos—have taken steps to maintain some level of secrecy by limiting access to journalists, prohibiting photography, and, in the case of industrial animal agriculture, lobbying to criminalize such actions.¹¹²² This lack of visibility and lack of transparency limits public reporting and fosters the type of closed environment that allows disease to prosper. It also inhibits scientific research and disease monitoring. However, often, authorities are largely reliant on these same industries to self-report when a disease outbreak occurs. Many producers, we were told, are “less than enthusiastic” about reporting disease, while some attempt to shun regulators altogether.¹¹²³ Public records requests reveal that, in the wake of COVID-19 outbreaks on Utah mink farms, for example, the State Department of Public Health was denied access to the infected fur farms while attempting to carry out testing in an effort to contain the spread.¹¹²⁴ Similarly, Fur Commission USA, the industry’s largest trade group, issued warnings to its members not to allow reporters or researchers near their mink sheds, going so far as to circulate photographs of a *New York Times* reporter’s rental car and license plate.¹¹²⁵

1119. “Defend the Flock - Biosecurity 101,” *USDA Animal and Plant Health Inspection Service*, last modified April 25, 2021, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/defend-the-flock-program/dtf-biosecurity>.

1120. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

1121. Mink waste is also used for fertilizer leading to concerns of potential fecal-oral pathogen transmission. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

1122. “Ag-Gag Laws,” *Animal Legal Defense Fund*, accessed May 9, 2023, <https://aldf.org/issue/ag-gag/>.

1123. Member of National Center for Emerging and Zoonotic Infectious Diseases, CDC, background interview, September 1, 2021.

1124. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

1125. Sonia Shah, “Animals That Infect Humans Are Scary. It’s Worse When We Infect Them Back,” *The New York Times*, January 19, 2022, <https://www.nytimes.com/2022/01/19/magazine/spillback-animal-disease.html>.

Complex Drivers of Disease

Human behavior drives disease emergence. While animals are reservoirs of zoonotic pathogens, these pathogens more often than not spill over as a result of human action.¹¹²⁶ Some of these actions involve direct use of animals, while others are indirect drivers of disease emergence. Both types of causes must be addressed in order to prevent spillover, yet each poses unique regulatory challenges.

Industries have been built around the commodification of animals with little regard for zoonotic risk. Millions of foxes, mink, bobcats, and chinchillas are raised and processed each year to supply fur to the fashion industry. White tailed deer are bred in similar numbers in captive facilities to stock hunting ranches across the South. Meanwhile, live animal imports flow freely across the border from abroad, while at the same time, we harvest and kill millions of animals to ship back overseas. This unnatural mixing can give rise to new diseases, opening new doors for pathogens that might never have existed without our help—creating networks and channels through which disease can spread from animals to humans and back again. As it stands today, a significant portion of the American economy has been founded on the use and production of animals, and for that reason, this use remains a cultural blindspot. However, without proper guardrails in place, these same activities may threaten the lives of those whose livelihoods they support, as well as the population writ large.

While much of our risk could be reduced by better regulation of animal use, other drivers of disease emergence and reemergence are more complex and difficult to regulate. Large-scale trends such as deforestation, urban expansion, climate change, and habitat destruction heighten the risk of infectious disease.¹¹²⁷ From cutting down old growth forests to make room for residential development or filling wetlands to make more pastureland for cattle, our continued erosion of wild spaces has brought us uncomfortably close to displaced wild animals who harbor diseases that can jump to humans. It has also paved the way for increased interactions between domestic animals and wildlife, as well as between native and invasive ones. Just as healthy animals are less susceptible to disease, research has shown that healthy, intact ecosystems spawn fewer disease outbreaks than degraded ones.¹¹²⁸ Furthermore, biodiversity dilutes disease risk, acting as a natural buffer to the spread of pathogens.¹¹²⁹ As the health of ecosystems suffer and more wild species are lost, we place ourselves at greater risk of zoonotic spillover.¹¹³⁰ Actions that harm environmental health are likely to put human health in jeopardy as well.



1126. Jeff Tollefson, "Why Deforestation and Extinctions Make Pandemics More Likely," *Nature*, August 7, 2020, <https://www.nature.com/articles/d41586-020-02341-1>.

1127. Peggy Eby, Alison J. Peel, Andrew Hoegh, Wyatt Madden, et al., "Pathogen Spillover Driven by Rapid Changes in Bat Ecology," *Nature* 613 (2023): 340-344, <https://doi.org/10.1038/s41586-022-05506-2>.

1128. Yewande Alimi, Jonathan Epstein, Manish Kakkar, Guilherme Werneck, "Report of the Scientific Task Force on Preventing Pandemics," *Harvard Global Health Institute*, Harvard T.H. Chan School of Public Health, August 2021, <https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/08/PreventingPandemicsAug2021.pdf>.

1129. Jeff Tollefson, "Why Deforestation and Extinctions Make Pandemics More Likely," *Nature*, August 7, 2020, <https://www.nature.com/articles/d41586-020-02341-1>.

1130. Rajan Patil, Ch Satish Kumar, and M. Bagvandas, "Biodiversity Loss: Public Health Risk of Disease Spread and Epidemics," *Annals of Tropical Medicine and Public Health* 10, No. 6 (Nov/Dec 2017): 1432-1438, <http://www.atmph.org/text.asp?2017/10/6/1432/222642>.

Although better regulation of animal use is an important first step to reducing zoonotic risk, equally important is acknowledging these underlying drivers of disease emergence. No single piece of legislation is likely to be able to speak to each of these vast regulatory challenges. Instead, these problems demand deliberate, steady effort, working to protect and restore fragile ecosystems, while at the same time addressing the root causes of habitat loss.

Design

This group of insights describe problems stemming from institutional, legislative, and regulatory design. They respond to the question: What are the structural issues that undermine regulation and prevent agencies from operating effectively?

Government as a Market Participant

While many animal markets exist entirely within the private sector, there are several for which the government acts not simply as a regulator, but as an active participant, creating and benefitting from the market itself. In these cases, state-sponsored activities may contribute to disease spread.

In the public market of hunting and trapping, state departments of fish and game are reliant on the sale of hunting licenses, and, by proxy, the sale of wildlife, to fund their own agencies.¹¹³¹ These incentives may allow disease risk to be overlooked in favor of revenue, for example, in the case of state-run feeding grounds for elk. Here, in an attempt to keep population numbers high and protect hunting revenue, Wyoming has created artificial environments of 800 or more animals per acre, in which diseases like brucellosis are found at thirteen times normal levels.¹¹³² In instances like these, the government abandons its role as an impartial regulator and moves from a referee on the sidelines to a player in the game.

Government-owned and operated wildlife farms produce hundreds of thousands of game birds to be released on public lands for hunting each fall. While some of these species are neither native nor adapted, and, in fact, damaging to local ecosystems that these agencies were created to protect, there is strong consumer demand for hunting these birds.¹¹³³ As one state agency put it, “We raise pheasants because people like to hunt them.”¹¹³⁴ However, this production process increases the risk of diseases including avian influenza, with documented H5N1 outbreaks at 16 game bird farms in the last year alone.¹¹³⁵

While many animal markets exist entirely within the private sector, there are several for which the government acts not simply as a regulator, but as an active participant, creating and benefitting from the market itself. In these cases, state-sponsored activities may contribute to disease spread.

1131. Dean Lueck, “An Economic Guide to State Wildlife Management,” *Property and Environment Research Center*, PERC Research Study RS-002 (December 2017) https://www.perc.org/wp-content/uploads/old/rs00_2.pdf.

1132. Bruce Smith, “Elk Winter Feeding = Disease Facilitation,” *The Wildlife Professional* 7, No. 12 (December 2013): 42-47, https://www.researchgate.net/publication/259198022_Elk_Winter_Feeding_Disease_Facilitation.

1133. In other cases, the state acts as a buyer, purchasing wild birds from breeding farms for \$13 or \$14 each while also selling permits to the hunters who will shoot and, later, eat them. Robert Miller, “From the Game Birds We Pay to Bring to CT to the Turkeys That Roam the State,” *CTInsider*, October 30, 2021, <https://www.ctinsider.com/columnist/article/Robert-Miller-From-the-game-birds-we-pay-to-16572899.php>.

1134. “Pheasant Management Program,” *Pennsylvania Game Commission*, accessed May 9, 2023, <https://www.pgc.pa.gov/Wildlife/WildlifeSpecies/Ring-NeckedPheasant/Pages/PheasantManagement.aspx>.

1135. “2022-2023 Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks,” *USDA Animal and Plant Inspection Service*, last modified January 18, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-commercial-backyard-flocks>.

State-sponsored bounty programs and predator eradication programs are other methods used by state agencies to increase revenue from hunting licenses.¹¹³⁶ Yet, each of these interactions carries an inherent risk of disease. For example, to collect certain bounties, an individual not only must kill and interact with a dead or dying wild animal, but that person must also manually remove the animal's scalp with a knife, exposing them to blood, saliva, and cerebrospinal fluid from the animal's brain.

While in some cases the government intervenes to protect its own interests, in other cases, policy is inspired by a desire to cater to powerful industry groups or voter blocks. In particular, both federal and state agencies go to extreme lengths to support animal agriculture. Direct assistance in the form of \$40 billion in annual subsidies is coupled with programs like the Bureau of Land Management's Horse Adoption Program. This program seeks to eliminate competition for livestock, who graze on public lands at below market rates, by removing wild horses and providing subsidies for those who adopt horses from the program.^{1137 1138} In addition, the federal government sponsors the direct killing of over one million animals a year through the use of traps, poisons, and other means carried out by USDA's Wildlife Services to eliminate predators such as mountain lions who may prey on livestock, as well as animals who may compete with livestock for forage or other resources.¹¹³⁹

Deep cultural roots as well as aggressive lobbying may help explain government-sponsored involvement and participation in protecting some of the animal markets discussed here. Many of these activities, on their face, may not otherwise seem justified. Conflicts of interest corrupt and undermine objective regulation across wide swaths of animal industry, making the public more vulnerable to disease.



Conflicts of interest corrupt and undermine objective regulation across wide swaths of animal industry, making the public more vulnerable to disease.

Funding Not Proportional to Risk

More people died in one day in 2020 from COVID-19 complications than from the attacks of September 11th.¹¹⁴⁰ Yet the FY2023 defense budget released by President Biden appropriated only \$468 million for pandemic preparedness compared to \$773 billion allocated for defense.¹¹⁴¹ On a percentage

1136. Wildlife Services is an agency of the USDA that kills millions of wild animals each year on both public and private lands. Since its founding in 1885, the division has served largely to protect livestock and big game by eliminating species deemed predators or pests. The work of Wildlife Services is funded by tax dollars as well as individuals or institutions requesting assistance. However, the agency's activities, which take place on both public and private lands, kill both target and non-target species, altering ecosystems in ways that diminish biodiversity, degrade habitat, and ultimately, may increase the risk of zoonotic disease.

1137. "About the Program," *U.S. Department of Interior Bureau of Land Management*, accessed May 9, 2023, <https://www.blm.gov/programs/wild-horse-and-burro/about-the-program>.

1138. "Wild Horses and Burros: Issues and Proposals," *Congressional Research Service*, RL34690, last updated December 8, 2011, <https://crsreports.congress.gov/product/pdf/RL/RL34690/10>.

1139. "2022 Program Data Reports" *USDA Animal and Plant Health Inspection Service*, last updated May 16, 2023, https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_pdrs.

1140. Carolyn Crist, "COVID-19 Deaths Surpass 9/11 Deaths in Single Day," *WebMD*, December 10, 2020, <https://www.webmd.com/lung/news/20201210/covid-19-deaths-surpass-911-deaths-in-single-day>.

1141. The Department of Defense Releases the President's Fiscal Year 2023 Defense Budget," *U.S. Department of Defense*, March 28, 2022, <https://www.defense.gov/News/Releases/Release/Article/2980014/the-department-of-defense-releases-the-presidents-fiscal-year-2023-defense-budg/>.

basis, spending on pandemic preparedness amounts to less than 1/10th of 1% of the total defense spending.¹¹⁴² Public health remains chronically underfunded despite the human costs associated with a pandemic as well as the economic toll of disease. This lack of funding belies a misunderstanding or mis-accounting of modern risks, including bioterrorism. As a result, government response is limited to less cost-effective, band-aid style measures rather than preventative solutions. Many research reports estimate the present value of zoonotic disease prevention costs for 10 years to be only about 2% of the costs of the COVID-19 pandemic.¹¹⁴³

Inspection and testing of both captive wildlife and livestock are severely limited by a lack of personnel and resources. For example, USDA employs 7,800 FSIS inspectors tasked with overseeing commercial slaughter at 6,800 federally inspected plants, with the goal of preventing diseased animals from entering the food supply.¹¹⁴⁴ ¹¹⁴⁵ In 2022, more than 9.9 billion animals were slaughtered at these federally inspected plants.¹¹⁴⁶ Assuming every inspector works full time, 52 weeks a year, each inspector is responsible for inspecting more than 1.2 million animals a year—nearly 25,000 per week, over 600 an hour.¹¹⁴⁷ ¹¹⁴⁸ These rates may not be realistic nor sustainable. The broad mismatch between the scale of animal production and the number of USDA personnel tasked with overseeing slaughter suggests that more resources are needed to ensure the safety of the production process. In addition, the USDA does not inspect the hundreds of thousands of industrial animal production facilities that grow and supply animals to these processing plants, leaving open significant opportunities for disease exposure prior to animals reaching the slaughterhouse.



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Additional funding for research is also needed to better understand the disease risks posed both by industries inside the United States and abroad. However, as is often the case, who provides the money matters. Within the livestock industry, for example, observers have noted, “Even the best scientists seem loath to say anything against the industry... With the decline in public research funding, it’s industrial animal agriculture that pays for virtually all the animal sciences research going on at land-grant universities today.”¹¹⁴⁹ As a result, most research focuses on how to enhance profitability of production rather than examining its potential risks to human health, ecosystems, or other problems.¹¹⁵⁰

1142. Lloyd J. Austin, “The Department of Defense Releases the President’s Fiscal Year 2022 Defense Budget,” *US Department of Defense*, May 28, 2021, <https://www.defense.gov/Newsroom/Releases/Release/Article/2638711/the-department-of-defense-releases-the-presidents-fiscal-year-2022-defense-budget/>.

1143. Andrew Dobson, Stuart Pimm, Lee Hannah, Les Kaufman, et al., “Ecology and Economics for Pandemic Prevention,” *Science* 369, No. 6502 (July 2020): 379-381, DOI: 10.1126/science.abc3189.

1144. “Don’t Let Your Outdoor Meal Become a Feast for Bacteria,” *USDA Food Safety and Inspection Service*, accessed May 24, 2023, <https://www.fsis.usda.gov/>.

1145. “Slaughter Inspection 101,” *USDA Food Safety and Inspection Service*, last updated August 9, 2013, <https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/slaughter-inspection-101>.

1146. “Livestock Slaughter Annual Summary,” *USDA Economics, Statistics, and Market Information System*, April 29, 2023, <https://usda.library.cornell.edu/concern/publications/r207tp32d>.

1147. Note that because both a pre-mortem and a post-mortem inspection are required, each inspector must carry out on average 2.4 million inspections per year (nearly 50,000 per week and over 1,200 per hour).

1148. “Livestock Slaughter Annual Summary,” *USDA Economics, Statistics, and Market Information System*, April 29, 2023, <https://usda.library.cornell.edu/concern/publications/r207tp32d>.

1149. Charles W. Schmidt, “Swine CAFOs & Novel H1N1 Flu: Separating Facts from Fears,” *Environmental Health Perspectives* 117, No. 9 (September 2009): A394-A401, <https://doi.org/10.1289/ehp.117-a394>.

1150. “Putting Meat on the Table: Industrial Farm Animal Production in America,” *The Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health*, April 29, 2008, https://www.pewtrusts.org/-/media/legacy/uploadedfiles/phg/content_level_pages/reports/pcifapfinalpdf.pdf.

Lack of Public Health Purpose

Rarely is regulation governing animal markets implemented to serve a public health purpose. Instead, laws are created for other reasons, such as to protect endangered species or set bag limits for hunting. Such laws are imperfect instruments to combat disease transmission. Without specific legislative intent to prevent disease, existing laws are ineffective and limited tools to mitigate risk. They leave open gaps, while at the same time, instilling a false sense of security among the public.

Rarely is regulation governing animal markets implemented to serve a public health purpose.

Many, and in some cases most, live animals enter the United States without being tested, physically inspected, or monitored for disease.

The live animal import market is a good example. Many, and in some cases most, live animals enter the United States without being tested, physically inspected, or monitored for disease. A report by the Government Accountability Office concluded to Congress that “[t]he statutory and regulatory framework for live animal imports has gaps that could allow the introduction of diseases into the United States.”¹¹⁵¹ These findings echoed those of the National Academy of Sciences, which determined that a “patchwork of federal policies and agencies with limited or ill-defined jurisdiction” resulted in “a lack of coordinated federal oversight” leaving “a significant gap in preventing and rapidly detecting emergent diseases.”¹¹⁵² These failings are largely a reflection of the fact that the primary responsibility of FWS in overseeing wildlife imports is ensuring that endangered species are not brought into the country without proper documentation. Their focus is on determining the animal’s conservation status, which is what FWS inspectors are trained to do.¹¹⁵³ Whether that animal is healthy or exhibits symptoms of disease is not their concern. A dead or dying wild animal with visible signs of disease may still be cleared by FWS for import, so long as the animal was not among a handful of protected species.¹¹⁵⁴

As the number one importer of live animals and wildlife in the world, the United States bears a substantial risk of importing dangerous zoonotic diseases.¹¹⁵⁵ However, the United States lacks a comprehensive system to screen imports for disease and has limited ability to share data between agencies.¹¹⁵⁶ Though the United States has invested vast resources in border protection, it does relatively little to keep zoonotic diseases from moving freely into its territories. Much of this failure can be attributed to the fact that disease control among captive animals is not a priority for FWS and is not included in the agency’s mandate.

1151. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

1152. National Research Council of the National Academies, Committee on Assessing the Nation’s Framework for Addressing Animal Diseases, *Animal Health at the Crossroads: Preventing, Detecting, and Diagnosing Animal Diseases* (Washington, D.C.: 2005)

1153. Robert Wallace, “Oversight of FWS: U.S. Fish and Wildlife Services: Testimony of Department of the Interior before the Senate Committee on Environment and Public Works regarding the U.S. Fish and Wildlife Service,” *U.S. Department of Interior*, February 5, 2020, <https://www.doi.gov/ocl/oversight-fws>.

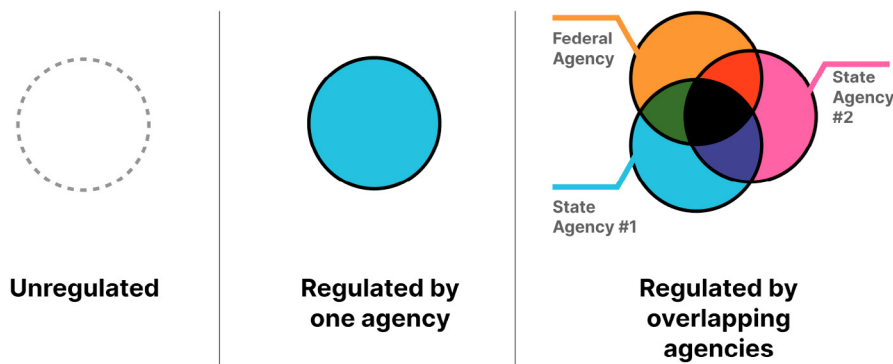
1154. Personal interview with former U.S. FWS inspector, interview done on background, June 10, 2021.

1155. Hilde Kruse, Anne-Mette Kirkemo, and Kjell Handeland, “Wildlife as Source of Zoonotic Infections,” *Emerging Infectious Diseases* 10, No. 12 (December 2004): 2067-2072, doi: 10.3201/eid1012.040707.

1156. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

The same is true in many other areas as well. The Animal Welfare Act, the primary piece of legislation governing animals in entertainment, animals in research, exotic animal breeders, zoos, auctions, commercial dog breeders, and online animal retailers, says very little about disease.¹¹⁵⁷ The word “disease” appears only a handful of times in the 242 pages of the Act and accompanying USDA regulations, while the phrase “zoonotic disease” is not mentioned at all.¹¹⁵⁸ Though some of the Act’s requirements may have secondary effects that reduce disease risk, without a guiding public health purpose, current regulation is largely ineffective at identifying and containing disease.

Overlapping and Underlapping Jurisdiction



A number of animal markets operate in regulatory gaps or legal gray areas. These gaps exist both among federal agencies (or state agencies) and between the federal and state levels. Markets that often fall into administrative cracks include fur farming, the exotic pet trade, captive hunting, big game farming, and backyard bird breeding. Troublespots arise when animals do not fit neatly into the predefined categories of “wildlife,” “livestock,” or “companion animals.” For example, a state may require vaccinations for dogs and cats, but fail to account for non-traditional pets such as prairie dogs or chimpanzees.¹¹⁵⁹ These problems are exacerbated when animals we associate with one of these categories operate as part of another—dogs who are raised as livestock by large-scale commercial breeders or white-tailed deer who are bred in captivity to supply captive hunting options. For this reason, one area of the spectrum that remains chronically under-regulated is wildlife in captivity. Without regulation, industries can operate in any manner they choose. However, conditions and practices that maximize profit—high stocking densities, limited vet care, poor facilities, inhumane handling—are also those that tend to maximize risk of zoonotic disease.

Regulatory voids are surrounded by legal gray areas where agencies are unsure of their own responsibilities and enforcement

Regulatory voids are surrounded by legal gray areas where agencies are unsure of their own responsibilities and enforcement powers, as well as those of other agencies.

1157. “Licensing and Registration Under the Animal Welfare Act. Animal and Plant Health Inspection Service,” USDA Program Aid No. 1117, last modified February 2019, <https://naldc.nal.usda.gov/catalog/7257529>.

1158. “USDA Animal Care: Animal Welfare Act and Animal Welfare Regulations,” *USDA Animal and Plant Health Inspection Service*, APHIS 41-35-076, May 2022, https://www.aphis.usda.gov/animal_welfare/downloads/AC_BlueBook_AWA_508_comp_version.pdf.

1159. “Great Ape Laws by State,” *Michigan State University*, Animal Legal and Historical Center, 2013, <https://www.animallaw.info/site/great-ape-laws-state>.

powers, as well as those of other agencies. Industries may benefit from this confusion and the associated lack of oversight. And, in some cases, whether it be captive hunting in Texas or elk and bison farming in the Midwest, there is a reluctance on the part of regulators to clear up confusion or mandate consistency across states when there are economic incentives not to do so. This manifests in a general unwillingness to take any actions that may be deemed as unfriendly to industry.

Where responsibility is shared between the federal and state level, states fill these gaps unevenly. For example, the federal Poultry Product Inspections Act (PPIA) provides exceptions that leave the regulation of smaller bird producers (1,000 birds or less) to the states. Some states, such as California, have taken up this charge and extended the federal guidelines to fill this gap.¹¹⁶⁰ However, many other states have chosen not to extend the Act's health and safety guidelines or lack the necessary resources to enforce such regulation, which can lead to significant regulatory holes around these smaller operations.¹¹⁶¹



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While the problems associated with underlapping jurisdiction are accessible and apparent, on the other end of the spectrum, similar issues may arise where agencies share competing jurisdiction. Involvement across multiple agencies and levels of government can muddy the waters and lead to a diffusion of responsibility among the relevant agencies and a lack of coordination between the parties involved. Often in these cases, regulators are unsure of their own duties and the duties of others, while at the same time are hesitant to infringe upon the domain of other agencies. Having everyone regulate runs the risk of no one regulating fully.

Live-animal food markets present one example where regulation is shared among local, state, and federal regulators. The patchwork of rules and interplay between agencies leads to confusion on all sides and a lack of consistency. One *New York Times* article noted that “the rules [governing live-animal food markets] are so confusing that officials at the Food Safety and Inspection Service of the United States Department of Agriculture initially told a reporter that their agency had nothing to do with live-animal markets” before later recognizing that they were responsible for overseeing the slaughter of certain types of animals at these markets.¹¹⁶² This confusion on the part of regulators is echoed by live market operators who may skirt the rules in some cases simply because they do not understand them.

1160. “Guidelines for Poultry Slaughter,” *California Department of Food and Agriculture*, accessed May 27, 2023, <https://www.cdffa.ca.gov/ahfss/mpes/pdfs/PoultryGuidelines.pdf>.

1161. Personal interview with California Department of Food and Agriculture Animal Health and Food Safety Services state veterinarian, May 27, 2021.

1162. Anne Barnard, “Meeting, Then Eating, The Goat,” *The New York Times*, May 24, 2009, <https://www.nytimes.com/2009/05/25/nyregion/25slaughter.html>.

Mismatch of Knowledge and Capacity

In some cases, there is a mismatch between which agencies have the knowledge to regulate risk and which have the authority or the on-the-ground capabilities to carry out regulation effectively. The situation at the border presents one example: The CDC has scientific expertise related to diseases. USDA APHIS has the ability to test animals, the veterinary staff to do so, and quarantine facilities needed to hold animals.¹¹⁶³ However, FWS, the “boots on the ground” agency tasked with reviewing most import shipments of live wild animals, has neither the knowledge of CDC nor the capacity of APHIS.¹¹⁶⁴ As a result, they do not have the resources to assess risk nor the ability to detain diseased shipments. FWS inspectors are provided only minimal disease training, and the agency lacks quarantine facilities.¹¹⁶⁵ As a result, “wildlife are imported daily with little or no health monitoring, increasing the likelihood that zoonotic or animal diseases will enter the United States.”¹¹⁶⁶ Some of this omission is not for lack of wanting—FWS inspectors have expressed a willingness to do more to address disease risk. However, at present, the agency has neither the ability to test and examine incoming wildlife for disease nor the authority to initiate disease testing on its own.¹¹⁶⁷

In some cases, there is a mismatch between which agencies have the knowledge to regulate risk and which have the authority or the on-the-ground capabilities to carry out regulation effectively.

Function

This group of insights describes issues that arise from the functioning of agencies and the application of regulation. They address questions such as: What limits the effectiveness of administrative actors? What pitfalls do agencies fall into that compromise and hinder their ability to implement their regulations?

Response is Limited and Reactionary

Too often, agencies act only when circumstances force their hand. As a general rule, there are very few comprehensive risk analyses in place to identify zoonotic threats and address them proactively.

Instead, regulators at both the state and federal level too often wait until an outbreak has occurred, focusing exclusively on containment. While some disease threats are novel, for many others, there is already sufficient information and motivation to take preventive measures now and stop future outbreaks—or in the case of imports,

Too often, agencies act only when circumstances force their hand.

1163. USDA APHIS is constrained by understaffing issues. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

1164. The USDA has the ability to quarantine livestock in USDA facilities when required, as is the case with live commercial birds and poultry. However, few other agencies have the capacity to keep and quarantine animals on this scale. Without the ability to detain and inspect animals, enforcement options are substantially limited. “Import: Bring Live Animals Into the United States,” *USDA Animal and Plant Health Inspection Service*, last updated March 1, 2023, <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-and-animal-product-import-information/live-animal-imports/import-live-animals>.

1165. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

1166. National Research Council of the National Academies, Committee on Assessing the Nation’s Framework for Addressing Animal Diseases, *Animal Health at the Crossroads: Preventing, Detecting, and Diagnosing Animal Diseases* (Washington, D.C.: 2005)

1167. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, Report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

to prevent known diseases from establishing a foothold inside the United States. The introduction of mpox to the United States provides an illustration of why prospective policy is needed. It is described in a 2010 report by the Government Accountability Office, a non-partisan legislative branch agency that conducts audits, investigations, information gathering, and evaluations on behalf of Congress:

Since the 1970s it has been well known that monkeypox, a zoonotic disease, was endemic to Africa. However, according to CDC officials, CDC did not have a process to conduct a risk assessment on the potential movement of monkeypox to the United States. Furthermore, they said, if such a risk assessment process had been in place, CDC might have restricted the importation of certain animals from Africa. After a 2003 outbreak of monkeypox in the United States, which sickened over 70 people, CDC restricted the importation of African rodents and other animals that may carry the monkeypox virus. However, CDC still allows the importation of rodents from countries outside of Africa, and these imported rodents are not subject to examination to determine whether they may be carrying zoonotic disease... For example, mice, rats, and gerbils are not screened for zoonotic diseases, but the animal family that includes these animals has been found to harbor 21 zoonotic diseases.¹¹⁶⁸

The GAO report, commissioned by Congress, concluded that, “CDC generally reacts only when a zoonotic disease problem arises” and that “CDC’s regulations are limited to specific species and regions and do not comprehensively prevent the importation of animals that are known to present a high risk of zoonotic diseases.”¹¹⁶⁹ By contrast, a more forward-looking policy might establish a comprehensive system for evaluating zoonotic risk and make prospective, real-time decisions as to whether to allow imports of a given species from a particular region. Imports might be pre-screened for disease prior to entering the country rather than waiting for those same diseases to establish themselves in the United States after they arrive. From an economic perspective, these public health risks should often outweigh the potential harm to a handful of animal importers. Even where imperfect knowledge exists, a cautious approach to protecting public health may be preferable to a “wait-and-see-style” of policymaking.

While proactive approaches require additional work and administrative capital, in the long run, they may save costs and lives. For example, in response to the ongoing H5N1 outbreak the government has been reluctant to require vaccination among poultry flocks, but instead has paid more than \$150

The GAO report, commissioned by Congress, concluded that, “that CDC generally reacts only when a zoonotic disease problem arises.”

1168. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

1169. “Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases,” *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.



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million in indemnification payments to producers whose flocks were lost as a result of the outbreak.^{1170 1171}

At present, policymakers are often reluctant to address future risk and narrowly circumscribe responses while ignoring related issues. For example, in 2011, the governor of Ohio refused to adopt regulations that would have limited the ownership of dangerous exotic animals.¹¹⁷² Six months later, in what came to be known as the “the Zanesville Exotic Massacre,” forty-nine exotic animals, including tigers, lions, baboons, and bears were slaughtered by law enforcement after their owner released them from their cages.^{1173 1174} Among these animals was a macaque monkey thought to be carrying Herpes B virus, which is 67% fatal in humans.^{1175 1176} The incident led to stricter exotic pet laws in Ohio but nowhere else in the country.

It is essential to move beyond what has happened in order to proactively address and prevent what could happen. To do this, policymakers must first take a comprehensive and holistic view of risk and sustain this focus long enough to affect meaningful change.¹¹⁷⁷

Inter and Intra-Agency Siloing

Poor interagency communication and the siloing of information, particularly among the USDA, FWS, CDC, and CBP, undermine regulation and enforcement. Every agency has their own culture, protocols, information systems, and institutionalized thinking about how to handle disease.¹¹⁷⁸ Each of these characteristics can act as a barrier to effective interagency cooperation, limiting the flow of information. For example, officials from both FWS and the CDC indicated that, to their knowledge, the LEMIS data, which describes wildlife entering the country and is collected by FWS, has not been shared with the CDC. However, the information described by the data—namely what types of wild animals are entering the country, where they came from, where they are going, and, by implication, what diseases they may carry—appears quite

Poor interagency communication and the siloing of information undermine regulation and enforcement.

1170. “USDA Pays \$146 million in Bird Flu Indemnities,” *Food and Environment Reporting Network*, April 28, 2022, https://thefern.org/ag_insider/usda-pays-146-million-in-bird-flu-indemnities/.

1171. “H5N1 Bird Flu: Current Situation Summary,” *Centers for Disease Control and Prevention*, last updated May 10, 2023, <https://www.cdc.gov/flu/avianflu/avian-flu-summary.htm>.

1172. “Ohio Governor Cracks Down on Exotic Animals,” *NBCNews*, October 21, 2021, <https://www.nbcnews.com/id/wbna44990032>.

1173. Christina Caron, “Zanesville Animal Massacre Included 18 Rare Bengal Tigers,” *ABC News*, October 19, 2011, <https://abcnews.go.com/US/zanesville-animal-massacre-included-18-rare-bengal-tigers/story?id=14767017>.

1174. Matt Ampleman and Doug A. Kysar, (2016) “Living with Owning,” *Indiana Law Journal* 92, No. 1, Article 8 (2016): <https://www.repository.law.indiana.edu/ilj/vol92/iss1/8>.

1175. Cristina Corbin, “Police Say All Escaped Exotic Animals Accounted for, Diseased Monkey Likely Eaten,” *Fox News*, December 1, 2015, <https://www.foxnews.com/us/police-say-all-escaped-exotic-animals-accounted-for-diseased-monkey-likely-eaten>.

1176. “Herpes B Virus Information Sheet,” *Pennsylvania Department of Health*, January 4, 2013, <https://www.health.pa.gov/topics/Documents/Diseases%20and%20Conditions/Herpes%20B%20.pdf>.

1177. “Zika response must not drain research funds,” *Nature* 537, no. 7 (September 2016): <https://doi.org/10.1038/537007a>.

1178. Colin Jerolimack, “Who’s Worried About Turkeys? How ‘Organisational Silos’ Impede Zoonotic Disease Surveillance,” *Sociology of Health & Illness* 35, No. 2 (February 2013): 200-212, <https://doi.org/10.1111/j.1467-9566.2012.01501.x>.

relevant to the CDC's larger mission of protecting public health. As another example, CBP has developed a web-based portal for exchanging trade information among federal agencies, yet neither FWS nor the USDA has full operational access to this platform, preventing the sharing of information on live animal shipments as well as tracking of violations.¹¹⁷⁹ These types of informational silos exist not only at the regulatory level but at the scientific level as well. Each agency we spoke to including FWS, USDA, and USGS has their own pathology lab but few, if any, protocols or conduits for sharing scientific findings.

Poor interagency communication, in some cases, may also be a result of agency competition. When lobbying for limited funds, few regulators want to cede control to another agency, even when that agency may be better equipped to address the problem at hand. With no single coordinating entity, fiefdoms persist, agencies become politicized, and their effectiveness is marginalized. Some of these problems could be remedied by realigning incentives to encourage or require information sharing. Yet, this is unlikely to occur without mandates and infrastructure in place to do so.

We also observed siloing within individual regulatory agencies. Different departments within these larger agencies hold competing functions and may not always share information laterally with other teams. For example, scientists—biologists, pathologists, and others—may operate quite independently from those drafting regulations within that same administrative agency, resulting in regulations that do not always reflect the best available science or even the agency's own findings.

Incentives Control When Regulation Does Not

Where self-interest and public interest point in opposite directions, oversight is needed to ensure that producers follow best practices. In the absence of such regulation, misaligned incentives often enhance risks to public health.

The USDA's indemnification program compensates producers for animals lost to disease or culled to contain disease spread. However, while the program covers traditional livestock and a handful of additional species like deer, no payments are made to fur farms or other operations raising non-compensated species. Producers in those industries have little incentive to report infectious disease outbreaks at their facilities. Rather than losing some of their animals to disease, they could be asked or required to cull all of their animals without compensation. In addition, reputational harm, both to them as individuals and to the industry as a whole, may weigh heavily against reporting, especially where powerful trade groups discourage it. Instead of requiring these industries to undergo monitoring, testing, or inspection to ensure that disease is reported, the USDA largely leaves them to their own devices.¹¹⁸⁰ The present structure makes the public vulnerable and keeps regulators largely in the dark.

Where self-interest and public interest point in opposite directions, oversight is needed to ensure that producers follow best practices. In the absence of such regulation, misaligned incentives often enhance risks to public health.

1179. "Live Animal Imports: Agencies Need Better Collaboration to Reduce the Risk of Animal-Related Diseases," *United States Government Accountability Office*, GAO-11-9, November 2010, <https://www.gao.gov/assets/gao-11-9.pdf>.

1180. Veterinarians are required to report positive diagnosis of certain notifiable diseases to animal health officials. However, it is ultimately the producer's choice whether to hire a veterinarian to examine sick animals. Many do not. In addition, very few vets will treat captive-farmed wildlife, as these animals fall outside the expertise of both small animal vets, who treat companion animals, and large animal vets, who treat traditional livestock.

In the absence of regulation, incentives to maximize profit may create conditions conducive to disease spread.



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In the absence of regulation, incentives to maximize profit may create conditions conducive to disease spread. For example, an importer shipping animals in improper containers may know that although many animals will die in transit, these losses will be outweighed by the benefits of cheaper shipping materials. Similarly, a contract farmer knows that meat producers pay by the pound, so the health of the animals is of less consequence than their weight. A pet store owner may realize that paying for vet care for animals sold for \$6 each will never make financial sense, even if, now and again, a whole display case of animals is lost to disease. In these circumstances, regulation can be effective at realigning incentives to ensure public health is not written off by producers as a negative externality.

Educational Deficiencies and Lack of Preparedness

Policymakers, law enforcement, medical staff, and the public in general, tend to be undereducated when it comes to zoonotic disease. Outside of foodborne illness, current regulations do little to alert the public to potential risk. When a child enters a petting zoo, for example, there are no required signs to alert parents about potential disease risk. That child may go on to touch the animals, pick up feed or hay from the animals' environment, and afterwards, eat food without first stopping to properly wash their hands. Similarly, customers at

captive hunting operations reported that ranch operators made no mention of disease risk or sanitation practices before sending them out to kill and retrieve exotic animals. The same is often true at pet stores where customers purchase animals with little or no understanding of the disease risks those animals may carry. Risk disclosures are required in the restaurant industry where menus alert consumers to the risk of foodborne illness and bathroom signs urge employees to wash their hands before returning to work. Imposing a similar strategy at pet stores, animal auctions, fairs, and other public venues where humans and animals interact may go a long way toward reducing transmission. As it stands, many Americans believe that because an activity is legal, it must be safe or because an animal is offered for sale, they must have been checked for disease. However, this is simply not the case.

While a handful of zoonotic pathogens such as Zika virus and SARS-CoV-2 capture the public consciousness, most are not well known. First responders and medical personnel are not always equipped to handle or diagnose novel or lesser known diseases, in particular those associated with non-native species such as exotic pets.¹¹⁸¹ In the Midwest mpox outbreak (referenced above), for example, the index patient, a three-year old girl from Wisconsin, was not diagnosed. Her spherical skin lesions and

1181. In the example of the escaped macaque monkey (referenced above) who was thought to be carrying Herpes B, one officer explained to the authors of this report the predicament faced by police, whose only law enforcement training directed him to shoot the animal, even though he feared that doing so in this case may risk dispersing blood and potentially contaminated bodily tissue.

other symptoms were written off as an anomaly, until weeks later when her mother and dozens of other patients began falling sick. Hers was the first case of mpox in the Western hemisphere, and emergency room doctors seldom search for rare foreign diseases in patients with no history of travel.¹¹⁸² Nor did the family who purchased the infected prairie dog realize that the animal could make them sick. Public education, in this respect, would be beneficial at every level from lawmakers to agency staff to the public to enforcement officials on the front line carrying regulations out.

Inequities in Disease Risk

There is a heightened level of zoonotic disease risk among underserved and poor populations.¹¹⁸³ This increased risk is driven by proximity to animals through the course of employment, the location of animal markets themselves, and human settlement patterns. At present, policy does little to address these inequities.

Workers from poor and underserved communities supply labor for many of the animal markets examined here and accordingly may be more likely to be affected by zoonoses.¹¹⁸⁴ Studies have shown, for example, a higher prevalence of influenza viruses among those with occupational exposure to pigs, but the same is also true of their families, and in some cases, the communities themselves that surround hog operations.^{1185 1186 1187} By contrast, wealthier Americans tend not to hold hands-on jobs that involve direct contact with animals. In industries such as food production, for example, a large percentage of slaughterhouse and meat-packing workers are low-income people of color, including workers from Mexico and other parts of Latin America.¹¹⁸⁸ While these individuals are disproportionately exposed to disease risks inherent in animal operations, at the same time, they tend to be less likely to report risks or to seek out preventative or post-incident healthcare.^{1189 1190} Outreach efforts and public education campaigns may also be less effective in targeting these populations.

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The geographic location of animal markets also puts some individuals at higher risk than others.¹¹⁹¹ CAFOs are more likely to be located in low-income communities. In Eastern North Carolina, where industrial swine facilities dominate the landscape and stand side-by-side with, in some cases within a few

1182. B. Lee Ligon, "Monkeypox: A Review of the History and Emergence in the Western Hemisphere," *Semin Pediatr Infect Dis.* 15, No. 4 (October 2004): 280-287, doi: 10.1053/j.spid.2004.09.001.

1183. David Molyneux, Zuhair Hallaj, Gerald T Keusch, Donald P McManus, et al., "Zoonoses and Marginalised Infectious Diseases of Poverty: Where Do We Stand?" *Parasites and Vectors* 4, No. 106 (June 2011), <https://doi.org/10.1186/1756-3305-4-106>.

1184. Maria C. Mirabelli, Steve Wing, Stephen W. Marshall and Timothy C. Wilcosky, "Race, Poverty, and Potential Exposure of Middle-School Students to Air Emissions from Confined Swine Feeding Operations," *Environmental Health Perspectives* 11, No. 4 (April 2006): 591-596, <https://www.jstor.org/stable/3650943>.

1185. Kendall P. Myers et al., "Are Swine Workers in the United States at Increased Risk of Infection with Zoonotic Influenza Virus?" *Clinical Infectious Diseases* 42, No. 1 (January 2006): 14-20, <https://doi.org/10.1086/498977>.

1186. Gregory C. Gray, et al., "Swine Workers and Swine Influenza Virus Infections." *Emerging Infectious Diseases*, Vol. 13(12) 2007: 1871-8. doi:10.3201/eid1312.061323.

1187. Paul M. Lantos, Kate Hoffman, Michael Höhle, Benjamin Anderson, and Gregory C. Gray, "Are People Living Near Modern Swine Production Facilities at Increased Risk of Influenza Virus Infection?" *Clinical Infectious Diseases* 63, No. 12 (December 15, 2016): 1558-1563, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5146723/>.

1188. Further, an unknown percentage of full-time and part-time workers in these large operations are undocumented persons, who may be less likely to report illness or hazardous working conditions, and unable to seek medical care or to miss work in the event that they are sick.

1189. Emmanuel Scheppers, Els van Dongen, Jos Dekker, Jan Geertzen, et al., "Potential Barriers to the Use of Health Services Among Ethnic Minorities: A Review," *Family Practice* 23, No. 3 (June 2006): 325-348, <https://doi.org/10.1093/fampra/cmi113>.

1190. Charles W. Schmidt, "Swine CAFOs & Novel H1N1 Flu: Separating Facts from Fears," *Environmental Health Perspectives* 117, No. 9 (September 2009): A394-A401, <https://doi.org/10.1289/ehp.117-a394>.

1191. By and large, wealthier communities exist in more desirable locations that include higher elevations where there is less standing water and more bug protection, as well as more insulation from animal-based operations.

hundred yards of, residential homes, research has documented the presence of swine fecal bacteria on the exterior walls of homes and inside them, on kitchen countertops and cereal boxes.^{1192 1193} Proximity to animal production makes these populations more susceptible to the disease risks and can facilitate

Poverty and population density have been found to be predictive of disease risk in the United States.

the transmission of airborne viruses or bacteria such as *Coxiella burnetii*.¹¹⁹⁴ Similarly, live animal food markets, which pose high and well-known risks of zoonotic disease transmission, are predominantly found in low-income, minority, and immigrant communities.¹¹⁹⁵

Housing distribution patterns can also amplify the risk of zoonotic disease among vulnerable populations. For instance, homes in low-lying areas with more standing water may put residents

at higher risk for vector-borne diseases transmitted by mosquitoes from other animals to humans including West Nile fever, dengue, La Crosse encephalitis, chikungunya, and Zika.¹¹⁹⁶ Poverty and population density have been found to be predictive of disease risk in the United States.¹¹⁹⁷ Little is being done at a policy level to mitigate these disparate effects.

However, the additional risks and challenges faced by these disadvantaged groups increase the danger to all members of the public. How long would it take to recognize the emergence of a novel virus circulating among workers at an industrial swine facility? The answer may depend on a number of variables tied to the socioeconomic position of the infected workers. It may take longer, for example, if those workers live in a rural community with limited access to healthcare, longer if English is their second language, or if they delay seeking treatment because they lack health insurance or avoid medical care altogether because they fear immigration consequences.^{1198 1199} It may also take longer if these workers feel unable to report their illness to a supervisor or longer if they cannot miss work for fear of losing their jobs, meanwhile continuing to spread the virus to other employees. These delays can mean the difference between containment and outbreak, as pathogens move from livestock workers to the public at large. In this way, an unequal system may also be an unsafe one.



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An unequal system may also be an unsafe one.

1192. "Study: Fecal Bacteria from N.C. Hog Farms Infects Nearby Homes," *Environmental Working Group*, May 2017, <https://www.ewg.org/news-insights/news-release/2017/05/study-fecal-bacteria-nc-hog-farms-infects-nearby-homes>.

1193. Shane Rogers, Expert Report Brief Exhibit, Case 5:15-cv-00013-BR Document 330-6, filed May 5, 2017, <https://ncnewsline.com/wp-content/uploads/2017/05/brief-exhibit-dr-rogers-report.pdf>.

1194. "Environmental Racism," *Food Is Power*, accessed June 4, 2022, <https://foodispower.org/environmental-and-global/environmental-racism/>.

1195. Yingjie Wang, "LA's 'Wet Markets' Could Be On The Chopping Block," *LAist*, July 9, 2020, <https://laist.com/news/food/la-wet-markets-chopping-block-city-officials-proposed-ban-coronavirus>.

1196. "About Mosquitoes," *Centers for Disease Control and Prevention*, last modified March 4, 2020, <https://www.cdc.gov/mosquitoes/about/index.html>.

1197. Julie F. Obenauer, T. Andrew Joyner, and Joseph B. Harris, "The Importance of Human Population Characteristics in Modeling *Aedes aegypti* Distributions and Assessing Risk of Mosquito-Borne Infectious Diseases," *Tropical Medicine and Health* 45, No. 38 (November 2017): <https://doi.org/10.1186/s41182-017-0078-1>.

1198. Gregory C. Gray, Darrell W. Trampel, and James A. Roth, "Pandemic Influenza Planning: Shouldn't Swine and Poultry Workers Be Included?" *Vaccine* 25, No. 22 (May 30, 2007): 4376-4381, doi: 10.1016/j.vaccine.2007.03.036.

1199. Thomas Anthony Chávez, Selene C. Vences, Yazmin Irazoqui Ruiz, Josue De Luna Navarro, et al., "Critical Incidences in U.S. Health Care Systems Experienced by Undocumented Young Adults," *Health Equity* 5, No. 1 (2021): 569-576, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8665800/>.



CONCLUSION

Animal use in the United States occurs on a vast scale for a wide array of purposes. Much of this use takes place outside of public view and rarely garners the attention of lawmakers. Still, just as animal use is everywhere, zoonotic risk is everywhere too—with pathogens circulating unseen but all around us.

While risk cannot be eliminated, it can be reduced, in many ways that would scarcely be felt by the public at large. There are vast opportunities for reducing risk that would not require significant behavioral change. Most Americans have never attended an animal swap meet where kangaroos can be bought alongside ferrets and chickens. Many do not frequent drive-through zoos where they hand-feed alfalfa pellets to crowds of deer, ostrich, zebra, and elk. Most of us have never bought anything at an exotic animal auction or a captive hunting operation where we aimed to kill exotic species and native ones, raised in breeding facilities. Most of our coats are not made of foxes and mink, nor do we use bat guano to fertilize our lawns. Few of us raise camels in our backyards or drink their unpasteurized milk. We do not receive shipments of wild animals, captured overseas, for resale. We rarely compete in livestock shows. In fact, most Americans do not kill our own food or buy it from a market where we select which living animal we want to eat. Still, we are all exposed to risks from each one of these operations. No matter how fringe the activity may seem, its risk weighs on all of us and spreads far beyond just those individuals involved. How many COVID-19 patients ever visited the city of Wuhan?

Surveying this landscape of low-hanging fruit, lawmakers and regulators should consider whether each practice justifies the risk it poses. For activities that present great risk but relatively little value,

While risk cannot be eliminated, it can be reduced, in many ways that would scarcely be felt by the public at large.

economic or otherwise, the answer may simply be, “no.” For other practices, the cost-benefit analysis will pose a more difficult question. And for others still, where the practice is deemed too valuable to lose, we must regulate to reduce risk wherever possible. At present, we are not doing enough. The United States has no comprehensive strategy in place to address the threat of zoonotic disease. There are serious regulatory deficiencies across almost every animal industry. Large information gaps exist, and disease can seep between these cracks.

Some similarities may be found in an analogy to homeland security. The attacks of September 11th ushered in a new era of national defense. The impact from the attack was felt in the hearts and throats of the nation at large. For many Americans, COVID-19 did for infectious disease what 9/11 did for terrorism—making real a threat which, just moments before, had felt theoretical and far away. At the time of this writing, scientists continue to debate the precise origins of the virus but there is no question as to the impact it has had. Indeed, few aspects of daily life in the United States remain untouched.

The events of 9/11 forced us to re-examine risk and risk response. The failure of the intelligence community to prevent the attacks was deemed, in part, a function of its fractured nature: its gaps, lack of information sharing, and poor interagency coordination.¹²⁰⁰ In response, George W. Bush pulled 22 separate agencies and departments together to forge a new integrated cabinet level agency. The Department of Homeland Security was born of the specific goal of creating and carrying out a comprehensive strategy to safeguard the country against terrorism. We face a similar crossroads today with preventing pandemic-level disease. Our systems are not designed to prioritize disease detection, our institutions are siloed from one another, and wide regulatory gaps exist through which pathogens can spillover and spread. The status quo is not sufficient, and, as with terrorism, the stakes are too high for the problem to be ignored.

In 2003, a year after the Department of Homeland Security began, the department started a new initiative aimed at addressing the growing threat of bioterrorism. This BioWatch program routinely collects air samples from above thirty or more major metropolitan areas in the United States and analyzes the samples for the presence of biological weapons.¹²⁰¹ In particular, operators test the samples for what the CDC refers to as “Category A Agents.” Category A Agents are considered pathogens of highest risk to national security because of the likelihood they may be used in a bioterrorist attack. Seven of the nine pathogens listed under Category A are zoonotic in origin, including anthrax, Ebola, Marburg virus, plague, and tularemia.¹²⁰²

The purpose of the BioWatch program is to facilitate early detection of a bioterrorist attack by monitoring for the presence of dangerous pathogens. Yet, at the same time, the government does not conduct disease testing of animals known to be vectors of these same deadly pathogens. Commonsense policymaking urges us to do the easy thing first. While we collect samples in the sky to detect traces of biological agents, we may be unknowingly importing these pathogens in far greater numbers, sending them on to animal distributors and pet stores and ultimately into American homes and children’s bedrooms. So, while a deadly disease outbreak may be the work of anti-American terrorist

1200. “9/11 Commission Report,” *National Commission on Terrorist Attacks Upon the United States*, 2004, <https://govinfo.library.unt.edu/911/report/index.htm>.

1201. Dana Shea and Sarah Lister, “The BioWatch Program: Detection of Bioterrorism,” *Congressional Research Service Report* No. RL 32152, November 19, 2003, <https://sgp.fas.org/crs/terror/RL32152.html>.

1202. “Bioterrorism Agents/Diseases,” *Centers for Disease Control and Protection*, last modified April 4, 2018, <https://emergency.cdc.gov/agent/agentlist-category.asp>.

groups or hostile foreign powers, it may also stem from random chance—a source far more likely and, perhaps, more frightening. We consider the first case bioterrorism; the second, business-as-usual.

In the wake of COVID-19, we no longer have to imagine what a large-scale infectious disease outbreak would look like in the United States. Still, COVID-19 fatality rates in the U.S. hovered just under 2% for most of the early pandemic. What if, instead of this coronavirus disease, it had been another such as SARS, a cousin to COVID-19, with a mortality rate of 14%, or MERS, a disease caused by another member of the viral family, that is 32% fatal? What if one-third of the people you know who have contracted COVID-19 died of the disease? COVID-19 disproportionately affected elderly persons and those with weakened immune response. For other viruses, younger healthy persons are at greater risk.¹²⁰³ What if instead of sweeping through nursing homes, the virus swept through elementary schools, taking lives that had only just begun?

There is a quiet consensus within the scientific community that the next pandemic may be far worse than what we have just experienced. Such an event may also happen sooner than we think, as outbreaks become increasingly common.¹²⁰⁴ Still, there is reason to be hopeful. We have the capability today to radically reduce our risk—to lock the cockpit door.

Along with this capability comes great responsibility and moral obligation to do so. This is the sober challenge we are left with.

So, while a deadly disease outbreak may be the work of anti-American terrorist groups or hostile foreign powers, it may also stem from random chance—a source far more likely and, perhaps, more frightening.

1203. G. Dennis Shanks and John F. Brundage, "Pathogenic Responses among Young Adults during the 1918 Influenza Pandemic," *Emerg Infect Dis.* 18, No. 2 (February 2012): 201-207, doi: 10.3201/eid1802.102042.

1204. Katherine F. Smith, Michael Goldberg, Samantha Rosenthal, Lynn Carlson, et al., "Global Rise in Human Infectious Disease Outbreaks," *Journal of the Royal Society Interface* 11, No. 101 (December 2014): <https://doi.org/10.1098/rsif.2014.0950>.

GLOSSARY OF KEY TERMS

Animal

Any member of the biological kingdom of living things, Animalia—though the term refers most often to vertebrate members of the phylum Chordata. “Animal” may refer to any species of mammal, bird, reptile, amphibian, fish, crustacean, arachnid, or insect. This term includes both domestic animals, such as companion animals and livestock, as well as wildlife. For the purposes of this paper, we exclude humans from this category and instead use the term to refer to non-human animals. We use pronouns typically associated with humans (such as “he/she/they” and “who/whom”) when referring to animals rather than pronouns associated with inanimate objects (such as “it” or “that”).

Animal Market

Markets where animals or animal products are bought, traded, sold, or exchanged. These products may include living animals, dead animals, meat, animal parts, milk, eggs, fur, skins, leather, bones, and other lightly-processed goods derived from animal origins.

Captive Breeding

The process of breeding and raising wild-caught or otherwise non-domesticated species in enclosed, human-controlled spaces such as zoos or fur farms for the purposes of conservation, education, entertainment, food, meat, fur or other animal products.

Domestic Animals

Animals who have been selectively bred and genetically adapted over generations in service of human interests. “Domestic animals” are genetically distinct from their wild ancestors or cousins, and may have undergone physiological changes during the process of domestication in particular where humans bred the animals for specific traits or purposes. “Domestic animal” may refer to any species of livestock as well as companion animals such as horses, house cats, and dogs.

Exotic Pet

An animal held as a pet that belongs to a species other than those domesticated species commonly kept for companionship (such as cat, dogs, and horses), including, for example, ferrets, fowl, hedgehogs, chimpanzees, and so forth).

Live Animal Market

Areas or storefronts where animals are held alive and slaughtered on-site and on-demand for customers, most often for food.

Livestock

Domestic animals raised in captivity for agricultural purposes, including both consumption and labor.

Pathogen

A microorganism such as a virus, bacterium, fungus, or parasite that can cause disease. Pathogens may be transmitted in a number of ways, such as direct and indirect contact, droplet spread, and airborne transmission.

Spillover

An event in which a virus or other pathogen from animals jumps the species barrier to infect humans.

Reverse Zoonosis

A disease that is transmissible from humans to animals through a process known as reverse zoonotic disease transmission.

Wildlife

Animals who have not been domesticated. “Wildlife” often refers to animals, native or invasive, who generally live in the wild and are part of an ecosystem. The term “wildlife” may describe animals who are wild-born and wild-captured, as well as those bred and raised and farmed in captivity where the species, as a whole, has not undergone the process of domestication. (For example, an exotic pet may be considered “tame” in that the individual animal has become acclimated to humans; however, unless the species has been domesticated, the animal would still be considered “wildlife” in captivity.)

Zoonotic Disease

Infectious disease that occurs through the transmission of a pathogen between animals and humans. “Zoonotic disease” refers to a condition, often a constellation of symptoms, that arises from infection with a virus or other type of bacterial, fungal, prion, parasitic, or protozoan pathogen. Most commonly, zoonotic disease is transmitted through direct contact, indirect contact, droplet spread, vertical transmission, or through food, water, or vector borne infection. Pathogens that cause zoonotic disease in humans can often spread from one animal to another animal of the same or different species.