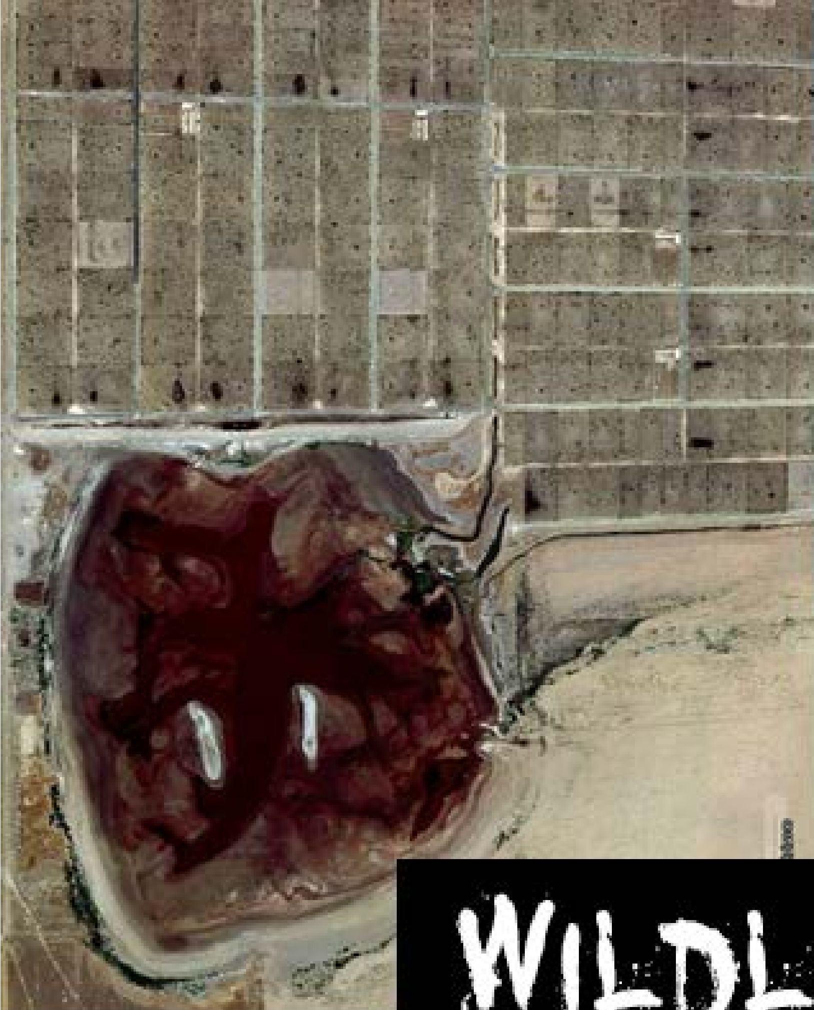


WILDLIFE IN DEEP SHIT

THE OVERLOOKED VICTIMS OF AMERICA'S FACTORY FARMS

Wildlife in Deep Sh*t:
Impacts of Industrial Animal Agriculture on Endangered Species

Just ten areas across the United States generate over *150 billion* pounds of farm animal waste each year. The farm animals that produce this waste - including cows, chickens, turkeys, and pigs - are typically housed in large industrial operations where their waste is collected in huge impoundments or piles, going virtually untreated before being dumped on nearby fields to runoff, leach, and fester. These operations and their waste management practices threaten the more than 85 imperiled species of wildlife in these areas that depend on continuing clean water and healthy ecosystems to survive and thrive.

In this report, the Center for Biological Diversity profiles endangered or threatened wildlife in each of these 10 embattled areas - ranging from the west to the east coast of the United States; the Atlantic Sturgeon to the Whooping Crane.

EXECUTIVE SUMMARY

Over the past 70 years, animal agriculture in the United States has evolved from small, diversified farms to large-scale, homogenized animal factories that produce a variety of meat, egg, and dairy products.

It is well documented that industrial-scale animal agriculture is a major driver of climate change, a substantial consumer of freshwater resources, and a leading cause of water quality impairment and ecosystem decline. Less examined is the impact industrial animal agriculture has on our nation's threatened and endangered wildlife. Our findings indicate that impact to be extensive.

It's time for the animal agricultural industry to be held accountable for its role in ecosystem collapse, habitat destruction, and species extinction.

In this report, we analyze and identify the top 10 places in the United States where industrial animal agricultural operations are located in close – and often direct – proximity to endangered and threatened fauna. To further illustrate this connection, we have created an interactive map to be viewed along with the report. That map, the first ever of its kind, compares the quantity of farm animal waste produced in each U.S. county with a list of the county's threatened and endangered species, and identifies waterways that are classified as impaired under the Clean Water Act.[i]

The Ten Places Profiled in this Report are:

(1) the San Joaquin Valley, California;
(2) the Lower Cape Fear River Basin, North Carolina;
(3) North Central Iowa;
(4) the Susquehanna River Valley, Pennsylvania;
(5) The Delmarva Peninsula, Delaware;
(6) The Oklahoma Panhandle;
(7) the Ozarks, Arkansas;

(8) the Lower Snake River Watershed, Idaho;
(9) the Lower Yakima Valley, Washington; and
(10) South Central Arizona.

Key findings:

- America's farm animals produce approximately 1.4 trillion pounds of animal waste each year, much of which is produced in factory farm-style operations.
- Most industrial animal agricultural operations have become consolidated in just a handful of regions.
- The top 10 regions for animal agriculture produce approximately 158.2 billion pounds of farm animal waste a year, over twenty four times the 6.5 billion pounds of estimated human waste in those same areas.
- Industrial animal agriculture in these 10 places causes stress to more than 85 endangered and threatened species of wildlife and the habitat they need to survive.
- Industrial animal agriculture is connected to large-scale negative effects on surrounding environments - contaminating air, water, and land.
- The most common threats to wildlife from industrial animal agriculture are water and air quality degradation; habitat encroachment and loss; and climate change.
- Aquatic species and their habitats are often most acutely threatened by pollution from industrial animal agricultural operations.
- Animal agriculture is a major driver of climate change, which is projected to commit over one-third of the Earth's animal and plant species to extinction by 2050.Dependent for its survival
- Because of continued dependence on industrially produced commodity crops such as corn and soy, industrial animal agriculture is intimately linked to the stresses that conventional monoculture cropping practices put on the environment and species, including from reliance on dangerous pesticides.

HERE: INSERT TABLE that includes all 10 areas, amount of annual animal waste, key environmental threats (like water pollution, air pollution, etc) and a few key endangered species.

Recommendations: Federal regulators have long ignored the growing problem of industrial animal waste to the detriment of the environment and public health. The federal regulatory agencies tasked with oversight and control of the industrial animal agricultural industry and the pollution that it produces, including the U.S. Environmental Protection Agency and the U.S. Food & Drug Administration, have failed to meaningfully acknowledge and categorically address the myriad environmental harms attributable to this industry, both at the operational level and cumulatively, and have been further hamstrung by industry-conciliatory roadblocks and agency funding cuts enacted by Congress. The federal government must act to provide consistent oversight and an effective national strategy to prevent continued environmental harm. Until the federal government gets serious about addressing the very real and significant effects of industrial animal agriculture on public health and the environment, state and local governments must act to uphold strong agricultural waste management and oversight initiatives in their jurisdictions. Individuals, retailers, and food service providers should additionally reduce consumption of meat and dairy products in order to lower the demand that drives the ever-increasing intensification of livestock production. These types of common sense measures are more necessary than ever to protect communities, water resources, and sensitive wildlife habitat.

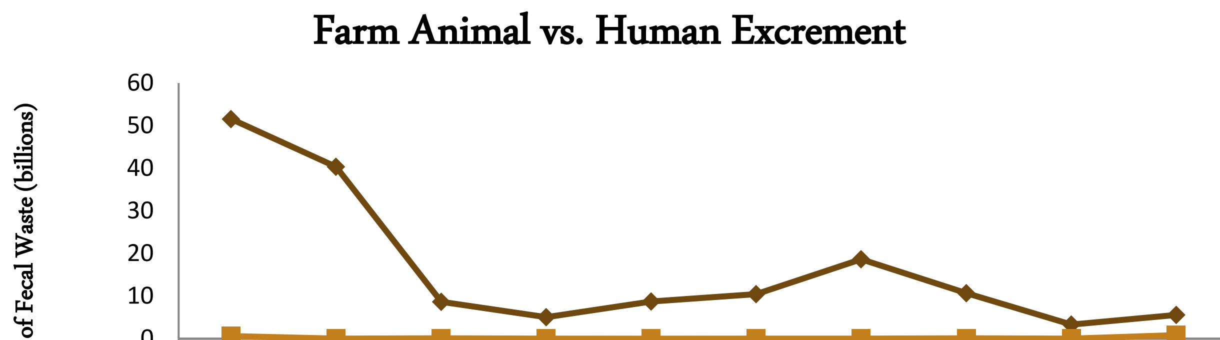
OVERVIEW: Pollution from Industrial Animal Agriculture Presents a Significant Threat to Wildlife

Wildlife in the United States faces considerable threat from unsustainable meat, egg, and dairy production practices. A majority of the farm animals raised in this country are produced in industrial operations that are not "'agriculture enterprises' … of a kind the Founding Fathers likely would have envisioned populating America's 'yeoman republic,'"[ii] but are, instead, large-scale operations that raise an extraordinary number of animals in confinement, normally through controlled feeding methods and without supporting any crops in the area where the animals are raised.[iii] Pollution from these operations is associated with a host of environmental problems, including contamination of air, water, and land resources; use and consumption of large amounts of freshwater resources; encroachment and conversion of indispensible species habitat; and release of climate change augmenting greenhouse gases.

Impairment of Fresh Water Sources and Aquatic Ecosystems

Industrial animal feeding operations are a significant source of water pollution in this country,[iv] with twenty-nine states identifying industrial animal agriculture as a leading contributor to water quality impairment.[v] Pollution from industrial animal agriculture - and the feed crops on which it relies - has been identified as a significant contributor to the more than 400 dead zones that exist worldwide, including domestically in the Gulf of Mexico and the Chesapeake Bay.[vi] This is in large part because of the massive amount of animal waste produced and disposed of at these operations. A factory farm with 800,000 hogs, for example, can produce one and a half times the annual waste generated by the people of Philadelphia.[vii]

Yet, despite universal agreement that human waste must be appropriately treated in order to protect the environment and safeguard against the spread of disease, wastes from industrial animal operations undergo virtually no treatment before being dumped onto nearby fields as "fertilizer." While organic manure can be a good source of fertilizer on small, diversified farms, the surplus amount of animal waste generated at industrial animal agricultural operations paired with the frequent use of, among other things, pharmaceuticals, pesticides, and heavy metals in production practices creates a distinctly different, and increasingly problematic, environmental and public health concern.



	San Joaquin Valley	Cape Fear Watershed	Susquehanna River Valley	Delmarva Peninsula	OK Panhandle	Snake River Watershed	N. Central Iowa	The Ozarks	Yakima Valley	Central Arizona
CAFOs	51,559,846,	40,320,505,	8,688,870,8	5,066,201,4	8,730,249,8	10,425,073,	18,631,231,	10,673,991,	3,313,292,4	5,596,184,4
Humans	625,921,345	39,203,190	97,933,880	39,351,015	3,921,742.5	21,986,322.	10,151,562.	91,770,672.	45,411,475	834851907.5

Specifically, industrial operations will typically accumulate farm animal wastes in open, pit-like impoundments or mountainous piles, and then spread or spray the virtually untreated wastes onto nearby fields. Studies show that industrial animal waste - a biological material - contains large amounts of organic matter and solids; heavy metals and other trace elements, including copper, zinc, and selenium; salts; nutrients, including nitrogen and phosphorus; pesticides; pharmaceutical residues; and disease-causing pathogens.[viii] Without proper treatment and management, the pollutants in this waste can reach waterbodies in a variety of ways, including: spills and leaks from waste impoundments directly into groundwater; application of waste onto fields in excess of the amounts the field and planted crops can incorporate – again, leading to runoff to surface waters and additional leaching into groundwater resources; application of wastes into and overtop of the ditches and tile drains that line application fields for the sole purpose of transporting those liquids (and any pollutants therein) off of the field and, often, towards nearby waterways; weather events, which can breach waste holding systems and send wastes directly into waterways; and, of course, intentional disposal of wastes directly into waterways.[ix]

The release of pollutants from industrial animal operation into surface and groundwater systems can significantly impair water resources, harming species health and aquatic environments. Nutrient pollution is the most pervasive, with effects to aquatic ecosystems that range from declining dissolved oxygen levels[x] to eutrophication and algae growth to reproductive impairment and exposure toxicity in wildlife and plants.[xi] Presently, 50 percent of U.S. streams suffer from medium to high levels of nitrogen and phosphorus pollution and 78 percent of assessed coastal waters show signs of eutrophication because of nutrient pollution; further, between 2003 and 2011, violation of drinking waters standards for nitrate doubled.[xii] Animal agriculture is a primary source for these nutrients.[xiii]

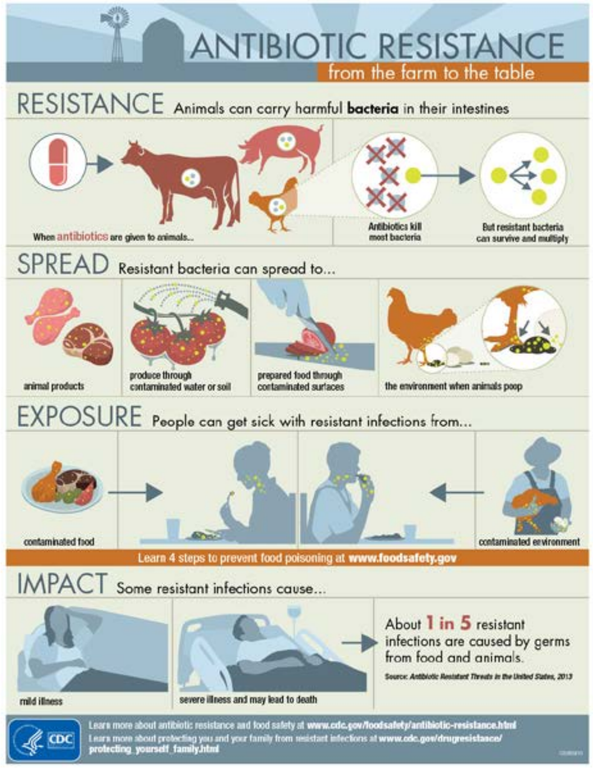
Table 6-1. Types of harmful or nuisance inland algae, toxin production, and potential adverse impacts.

Algae Group	Genera/Taxa	Toxins	Potential Adverse Impacts
Cyanobacteria	Anabaena, Aphanocapsa, Hapalosiphon, Microcystis, Nostoc, Oscillatoria, Planktothrix, Nodularia spumigena, Aphanizomenon, Cylindrospermopsis, Lyngbya, Umezakia	Hepatotoxins, neurotoxins, cytotoxins, dermatoxins, endotoxins, respiratory and olfactory irritant toxins	• Human and animal health impacts (i.e., gastrointestinal disorders, liver inflammation/failure, tumor promotion, cardiac arrhythmia, skin irritation, respiratory paralysis, etc.) • Water discoloration • Unpleasant odors and aesthetics • Hypoxia from high biomass blooms • Taste and odor problems in drinking water and in farm-raised fish
Haptophytes	Prymnesium parvum, Chrysochromulina polylepis	Ichthyotoxins	• Fish mortalities
Chlorophytes, Microalgae	Volvox, Pandorina	--	• Water discoloration • Localized hypoxia
Macroalgae	Cladophora	--	• Unpleasant odors and aesthetics • Localized hypoxia • Clogged water intakes
Euglenophytes	Euglena sanguinea	Ichthyotoxins	• Water discoloration • Fish mortalities
Raphidophytes*	Chattonella	Ichthyotoxins	• Fish mortalities
Dinoflagellates	Peridinium polonicum	Ichthyotoxins	• Fish mortalities
Cryptophytes	Cryptomonas, Chilomonas, Rhodomonas, Chroomonas, Hemiselmis, Proteomonas, Teleaulax$^{\Omega}$	--	• Water discoloration • Localized hypoxia
Diatom	Didymosphenia geminata	--	• Produce large quantities of extracellular stalk material resulting in ecosystem and economic impacts

** Raphidophytes are a marine algae, but can bloom in inland saline waters*
Ω Information from Marin et al. (1998).
Adapted from Lopez et al. 2008.

Pollution from animal agriculture carries an added risk to public health from associated pathogens, anthropogenic chemicals, livestock medicines and other emerging contaminants. For example, "[m]ore than 150 pathogens associated with industrial livestock production [are] associated with risks to humans, including the six human pathogens that account for more than 90% of food and waterborne diseases in humans."[xiv] As it relates to pharmaceutical use, over 80 percent - or 34 million pounds - of the antibiotics used in the United States are used in animal production.[xv] These antibiotics, as well as other pharmaceuticals such as hormones and steroids, are commonly used by industrial animal producers to make the animals grow larger faster, and to enable the animals to survived in incredibly cramped confinement barns and feedlots, where disease can spread rapidly.

Because farm animals typically do not metabolize all the pharmaceuticals they are fed, raw industrial animal waste tends to contain pharmaceutical residues, which remain in the waste even when spread or sprayed onto land application fields..[xvi] Once applied to fields, these pharmaceutical residues can leach into groundwater; bind to soil - changing soil characteristics and entering waterways through erosion; directly enter surface waters through runoff; and, potentially, be absorbed into plant tissues.[xvii] Such practices have been linked to the spread of antibiotic resistance,[xviii] as well as the release of endocrine disrupting hormones into the environment, which can disrupt normal hormonal patterns[xix] and lead to physiological and reproductive disorders in birds, fish, shellfish, turtles, gastropods and mammals.[xx]



Air Pollution, Climate Change, and Habitat Loss

Industrial animal operations produce a variety of noxious air pollutants, including ammonia, hydrogen sulfide, methane, nitrous oxide, particulate matter (PM 2.5 and PM10), and volatile organic compounds (VOCs), which directly impact species and their habitat.[xxi] While much of this pollution is released from the animals' waste - often as a result of collection, decomposition, and volatilization - it can also be released directly from the animals themselves. Further, dust and other particulate matters are released from dry manure, bedding, feed materials, animal dander, and, with poultry operations, feathers. Particulate matter is also formed by chemical reactions of precursor gases such as ammonia. Air pollution from industrial animal operations creates haze, fine particulate matter, and ozone and contributes to the impairment of land and water resources, leading to “dead zones” in waterways and acidification of soil and waters.[xxii]

Animal agricultural is also a major driver of climate change, producing a conservative estimate of between 10 and 25 percent of all global greenhouse gas emissions.[xxiii] Methane and nitrous oxide are the two greenhouse gases produced by animal agricultural operations that are of the greatest concern. Domestically, between 1990 and 2014 total greenhouse gas releases attributable to manure management practices alone rose by a total of 53.8 percent - equivalent to a 64.7 percent increase in methane emissions and a 24.9 percent increase in nitrous oxide emissions.[xxiv] As it relates to nitrous oxide, manure management ranks nationally as its third highest source, just behind agricultural soil management and stationary combustion.[xxv] With methane, it's the gases from the animals themselves - usually cattle - that constitute the second largest anthropogenic source of methane emissions in the United States, and when combined with manure management add up to a whopping 30.9 percent of all human-induced methane emissions.[xxvi]

Methane and nitrous oxide are of particular concern not only because of the large amounts released by industrial animal operations, but also because, based on their chemical composition, each has an incredibly powerful warming effect when released into the atmosphere, much greater than carbon dioxide. Methane has more than 20 times the global warming potential of carbon dioxide, while nitrous oxide has *nearly 300 times* the atmospheric warming potential of carbon dioxide.[xxvii] With climate change as one of the most significant issues currently facing biodiversity and species health, the considerable driving role that animal agriculture plays in it cannot be ignored.

Finally, the growth and development of industrial animal agriculture is the basis for intense habitat destruction and fragmentation - not just through direct conversion, but also due to animal agriculture's unsustainable dependence on habitat hungry commodity crops, and the major losses of aquatic habitats through water use and withdrawal. Studies estimate livestock production to be the world's largest user of land, either directly or through feed production, accounting for approximately 70 percent of all agricultural land use globally and 30 percent of the land surface of the planet.[xxviii] In the United States, for example, with farm animals consuming more than seven times the grain consumed by the country's human population, the bulk of domestic agricultural land use (which comprises slightly over 50 percent of total land use in the United States) is dedicated to growing cropland for livestock production.[xxix] And prospectively, land consumption for animal agricultural use is only expected to grow. According to recent projections, the amount of land needed to meet growing global food demands, including increasing global demand for meat and dairy products, is predicted to increase by 18 percent from 2000 to 2050 - resulting in an estimated 1 billion hectares of additional natural habitat loss.[xxx]

Agriculture is also responsible for an estimated 80-90 percent of annual water consumption in the United States, with water consumption by livestock alone estimated at 730 billion gallons annually.[xxxi] While a vast majority of water use in the United States goes towards growing feed crops for industrial animal agriculture - primarily soy, corn, and alfalfa, the animal operations themselves can also consume huge amounts of freshwater resources. For example, just one 5,000 cow industrial dairy operation can alone require over 60 million gallons of water annually.[xxxii] Combined, this makes animal agriculture a dominant agent of biological collapse, causing loss and change in biodiversity and habitat as well as contributing to water scarcity threats, and making these sensitive ecosystem even more vulnerable to water quality impairment.

METHODOLOGY

Endangered and threatened wildlife depend on clean water and healthy ecosystems to survive and thrive. In this report, the Center for Biological Diversity profiles several endangered and threatened species of wildlife in each of the 10 places in the U.S. where imperiled wildlife are most threatened by massive quantities of waste from factory farms.

In conducting this analysis, the Center compiled all county-specific livestock and poultry inventory data from the 2012 U.S. Department of Agriculture (USDA) *Census of Agriculture* - a survey conducted every five years by the USDA of American agriculture - and then developed statistical calculations of county-specific waste production values by multiplying livestock and poultry inventory data against U.S. Environmental Protection Agency farm animal waste production multipliers.[xxxiii] The *Census of Agriculture* is the leading source of facts and statistics about American agriculture. In it, USDA compiles and reports livestock and poultry inventory data on the national, state, and county levels, but does not disclose information below the county level. Therefore, all information about specific facilities or their locations is excluded from this report. Farm animal populations analyzed in this inventory include dairy cattle, beef cattle, turkey, broiler chicken, layer chicken, and swine populations. Annual inventory numbers of livestock and poultry prepared by the Department of Agriculture are based on information reported by farmers and ranchers and obtained by probability survey sampling methods. The *Census of Agriculture* is available online at http://www.agcensus.usda.gov/.

Table 3.3 Manure production per 1000 pounds live weight, on an annual basis.

Animal Species	Manure produced lbs./yr	Typical Handling System	Tons per Year for 1000 Animal Unit CAFO
Swine	29,000	Liquid	14,500
Poultry			
Broilers	28,000	Solid	14.000
Layers	22,000	Liquid	11,000
Turkeys	16,000	Solid	8,000
Beef	21,000	Solid	10,500
Dairy	30,000	Liquid	15,000
Humans	1,223[1]	Liquid	611

[1] Based on 150 lb avg. wt. per person producing 0.5 lb of fecal material per day

The Center then comprehensively analyzed the geographic area within the larger nationwide database, narrowing it down to the top 50 farm animal waste producing counties. The top 50 counties were then carefully evaluated against a matrix of agricultural statistical data, animal agricultural industry consolidation data, land use data, data regarding the potential for animal agriculture in these counties to cause or exacerbate the imperilment of threatened and endangered species, and other relevant data. In conducting this review, each species was evaluated using Fish and Wildlife Service (FWS) data, including completing a full county review in each of the profiled areas using FWS' Environmental Conservation Online System.[xxxiv]

The report synthesizes and summarizes this data by introducing each of the ten area in this top-ten list by county; providing a list of the federally-listed threatened and endangered species likely affected by animal agricultural practices in that defined geographic range; summarizing and comparing human and farm animal population and waste production numbers; and introducing some of the specific threats to each area due to animal agriculture. Each section concludes by profiling three specific imperiled species. While animal agriculture can be linked to significant affects to communities, consumers, and the farmed animals themselves, this first of its kind report focuses on threat to imperiled wildlife.

#1 San Joaquin Valley, California

Counties: Tulare, Fresno, Madera, Merced, Kings, Kern, Stanislaus (Human Population: 3,429,706[xxxv]; Farm Animal Population: 33,291,926[xxxvi])

Pounds of Poop Produced Annually by Human Population: 625,921,345[xxxvii]

Pounds of Poop Produced Annually by Animal Agriculture: 51,559,846,410[xxxviii]

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The San Joaquin Valley

With over 1.4 million dairy cows, 27 million chickens, 3.9 million turkeys, 138,000 beef cows, and a handful of hogs, the six counties in the San Joaquin Valley combine to rank first in areas where industrial animal agriculture threatens imperiled wildlife.[xxxix] Each year, San Joaquin Valley's dairy cows alone generate over 43 billion pounds of animal waste - a vast amount of the combined 51 billion pounds of waste generated annually by animal agriculture in the region. Indeed, in Tulare County, the more than 450,000 industrially farmed dairy cows produce five times more waste than the sewage in the New York City metro area.[xl]

Top Counties in Cow's Milk Sales ($ billions)	
Tulare, CA	1.8
Merced, CA	1.1
Gooding, ID	0.7
Stanislaus, CA	0.7
Kings, CA	0.6
Kern, CA	0.5
Yakima, WA	0.4
Lancaster, PA	0.4
Fresno, CA	0.4
San Joaquin, CA	0.4

Does not include counties withheld to avoid disclosing individual data.
Source: USDA NASS, 2012 Census of Agriculture.

Dairies acutely impact both water quality and quantity in the San Joaquin Valley. Dairy cows excrete an estimated 60-70 percent of the nutrients they ingest, and, corresponding with the growth of the dairy industry in the San Joaquin Valley, "dairy manure applied to land has increased exponentially, effectively doubling every 15 years," resulting in "an overall 16-fold
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increase in manure nitrogen output."[xli] Due to the "limited flow of water through the Valley, once [dairy] pollutants reach the water, they do not dissipate, resulting in a long term accumulation of these pollutants" in the environment, and an extreme threat to wildlife.[xlii]

Nitrate, one of California's most widespread groundwater contaminants, has also been linked to animal agricultural operations.[xliii] According to a recent study prepared for the California State Water Resources Control Board, in the San Joaquin Valley "[a]gricultural fertilizers and animal wastes applied to cropland are *by far* the largest regional sources of nitrate in groundwater."[xliv] As the study further explains, in excess of 2 million people in this region rely on groundwater from private wells or smaller waters systems not regulated by the state for drinking water, and "[m]ore than 85% of community public water systems in California (serving 30 million residents) rely on groundwater for at least part of their drinking water supply."[xlv]

Overuse of antibiotics in animal agricultureposes a further threat to water quality. Application of manure from animals fed the antibiotic Monensin, for example, has been shown to contaminate ground and surface water resources, and can be toxic in aquatic environments.[xlvi]

As it relates to air pollution, dairies produces approximately 37 percent of the ammonia in the San Joaquin Valley, with the other animal operations in the area producing an additional 34 percent (and all other sources such as motor vehicles and fertilizer manufacturing produce the remaining 29 percent).[xlvii] Dairies are also a major source of particulate matter and volatile organic compounds, two pollutants that have been linked to chronic non-attainment in the San Joaquin Valley of federal Clean Air Act standards for fine particulate matter and ozone (due to dairy emissions of volatile organic compounds).[xlviii] As a result, according to the San Joaquin Valley Air Pollution Control District, dairies "have a significant adverse impact on efforts to achieve the health-based air quality standards."[xlix] Winds from the San Joaquin Valley can even carry toxic air pollutants from these operations all the way into the Sierra Nevada Mountains, jeopardizing species in these seemingly pristine areas.[l]

Further, and perhaps even more significantly, cows are considerable producers of the heat-trapping greenhouse gases methane and nitrous oxide. In California, more than half of the state's methane emissions are from its dairy and beef operations.[li] In total, the agricultural sector in California contributed 8 percent of the state's total greenhouse gas emissions come from agricultural sources, with dairies accounting for over 4 percent of total emissions.[lii]

In sum, without change the dairies in the San Joaquin Valley are likely to be a cause of continued instability for more than 25 federally listed endangered and threatened species, as well the health and welfare of the communities in the San Joaquin Valley.

Profiles of Imperiled Species

A. Delta Smelt *(Hypomesus transpacificus)*
Status: Threatened

The health of delta smelt populations is considered a barometer for the ecology of the San Francisco Bay Delta, meaning that when the smelt's populations are in trouble, there is no question that their disappearance is a sharp cause for concern. At only about 5-7 centimeters long, the delta smelt is a small, slender fish.[liii] The smelt has a "steely blue sheen" and to some appears almost translucent.[liv] Delta smelt are found only in a narrow range from the Suisan Bay upstream through the Sacramento/San Joaquin River Delta.[lv] As one journalist described in 2015, the "countdown [for the delta smelt] toward extinction represents the failure of what was once the largest estuary between Patagonia and Alaska."[lvi]

This delta smelt is endangered due to water temperature fluctuations, impaired water quality, and habitat loss due to fresh water scarcity and withdrawal in the Sacramento-San Joaquin River Delta. [lvii] Delta smelt are highly sensitive to impaired water quality, including reduced water clarity and high levels of ammonia pollution - both of which are linked to industrial animal production. [lviii] Further, in California, livestock operations directly consume 188 million gallons of water per day - a number that doesn't take into account the massive quantities necessary to grow a confined animal's feed, which is estimated to comprise up to 98 percent of an animal product's water footprint and may bring water use estimates up to an astonishing 47 percent of California's water being consumed to produce meat and dairy products. [lix] Compounded with the fact that California is entering its sixth year of drought conditions[lx], these huge water diversions are a real problem for the health and continued survival of the delta smelt.

B. Shrimp and Vernal Pools

Vernal Pool Tadpole Shrimp *(Lepidurus packardi)*

Status: Endangered

Conservancy Fairy Shrimp (*Branchinecta conservatio)*

Status: Endangered

Longhorn Fairy Shrimp (*Branchinecta longiantenna*)

Status: Endangered

Vernal Pool Fairy Shrimp *(Branchinecta lynchi)*

Status: Threatened

Vernal pool fairy shrimp, conservancy fairy shrimp, longhorn fairy shrimp, and vernal pool tadpole shrimp are four extraordinary species of freshwater shrimp that depend on the health and continued presence of rare vernal pools in the Central Valley of California. Vernal pools are a distinctive type of wetland ecosystem that are ephemeral in nature, meaning that they will fill temporarily with water - usually during the winter and spring - and then disappear again until the next wet season.[lxi] "In California, where extensive areas of vernal pool habitat developed over a long geological timeframe, unique suites of plants and animals have evolved that are specially adapted to the unusual conditions of vernal pools."[lxii] In total, at least twenty listed species, including these four little shrimp, depend on these pools for survival.[lxiii] Reliant on the vernal pools' ecology, these tiny, unique shrimp have adapted to hatch, grow, breed, and lay eggs in a single wet season – usually only three to four months long. For example,

- ❖ Vernal pool tadpole shrimp, known as "living fossils,"[lxiv] are believed to have evolved in the Central Valley of California approximately 2 million years ago.[lxv]

Having relatively high reproductive rates, a large female can deposit as many as 6 clutches, with 32 to 61 eggs per clutch.[lxvi] When the annual rains return to fill their vernal pool habitat, long dormant vernal pool tadpole shrimp eggs may hatch in as few as four days.[lxvii]

- While the historic distribution of the conservancy fairy shrimp is unknown, it is believed to have once occupied vernal pool habitats throughout a large portion of the Central Valley and southern coastal regions of California.[lxviii] In the San Joaquin Valley, these shrimp can only be found at a single location in Merced County, as well as in a single location in Stanislaus County.[lxix]
- Though first collected in 1937, the longhorn fairy shrimp did not receive a formal description until 1990 - a description that, quite appropriately, focuses on its long antennae.[lxx] These antennae are so long, in fact, that they makes male longhorns easily distinguishable from other fairy shrimp.[lxxi] Designated as endangered, longhorn fairy shrimp are exceedingly rare.
- While there is little information on its historic range of the vernal pool fairy shrimp it is currently known to occur in the southern and Central Valley's of California (as well as in two small pool habitats in Oregon).[lxxii] Vernal pool fairy shrimp, like other vernal pool shrimp, are highly adapted to the environmental conditions of their ephemeral habitats, allowing for their eggs to remain dormant while the vernal pool is dry, and to only hatch when the water reaches above 50 degrees Fahrenheit.[lxxiii]

Tragically, vernal pools are in danger of disappearing, with 90 percent of California’s vernal pools already lost.[lxxiv] As California's vernal pools are degraded and slip away, so to do these miraculous little shrimp. Primary threats to these species include habitat loss and fragmentation due to urban development and agricultural conversion (including for animal agriculture), altered hydrology, and over- or under-grazing.[lxxv] Further, as the presence of nutrients (such as those contained in animal wastes) increase in and around vernal pools, the pools become susceptible to algae growth and eutrophication, causing water quality to decline and resulting in harm to these sensitive shrimp and their habitat.[lxxvi] In 1998, for example, an 11 million gallon spill of liquid waste from a large poultry operation damaged a wetland vernal pool system in the Merced National Wildlife Refuge, killing endangered vernal pool fairy shrimp and vernal pool tadpole shrimp.[lxxvii] These types of impacts are extreme but can be prevented, and must be if we would like to see the continued survival of these delicate shrimp.

C. California Tiger Salamander *(Ambystoma californiense)*

Status: Threatened in Central California; Endangered in the remainder of its range

With its wide mouth charmingly outlined in yellow, the California tiger salamander always looks like it’s smiling. Estimated to have disappeared from more than 50 percent of its historic range, California tiger salamander thrives in San Joaquin Valley’s annual grassland habitat, as well as the grassy understory of valley foothill hardwood habitats and, occasionally, along stream courses in valley foothill riparian habitats.[lxxviii] Like the fairy shrimp, the California tiger salamander depends on healthy vernal pools and ponds for breeding.[lxxix] One of the primary causes of the tiger salamander's decline is its loss and fragmentation of habitat from human activities, including as a result of displacement for agricultural expansion.[lxxx] As these unique and rare habitats disappear, the tiger salamander has fewer and fewer reasons to grin. Further, like other amphibians, the California tiger salamander is believed to be "extremely sensitive to contaminants due to their highly permeable skin which can rapidly absorb pollutant substances."[lxxxi] Therefore, since the critical habitat of the tiger salamander can overlap with the animal agricultural operations in this region, tiger salamanders are also subject to harm from contaminated animal agricultural runoff - including nutrient pollution and pesticide runoff.[lxxxii]

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Endangered and Threatened Wildlife in Tulare, Fresno, Madera, Merced, Kings, Kern, Stanislaus Counties, CA: Yellow-billed Cuckoo, Steelhead Trout, Giant Kangaroo Rat, Giant Garter Snake, San Joaquin Kit Fox, Least Bell's Vireo, Longhorn Fairy Shrimp, Vernal Pool Fairy Shrimp, Fresno Kangaroo Rat, Southwestern Willow Flycatcher, Delta Smelt, Conservancy Fairy Shrimp, California Tiger Salamander, California Red-legged Frog, Tipton Kangaroo Rat, California Condor, Buena Vista Lake Ornate Shrew, Green Sturgeon, Valley Elderberry Longhorn Beetle, Vernal Pool Tadpole Shrimp, Riparian Woodrat, Alameda Whipsnake, California Clapper Rail, Kern Primrose Sphinx Moth, Blunt Nosed Leopard Lizard, Riparian Brush Rabbit
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#2 Lower Cape Fear River Basin, North Carolina

Counties: Sampson, Bladen, Duplin, Pender (Human Population: 214,812; Farm Animal Population: 36,551,880)

Pounds of Poop Produced Annually by Human Population: 39,203,190

Pounds of Poop Produced Annually by Animal Agriculture: 40,320,505,810
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Top Counties in Hog and Pig Sales ($ millions)	
Duplin, NC	614.0
Sampson, NC	518.4
Sioux, IA	417.2
Washington, IA	316.1
Texas, OK	285.3
Lyon, IA	271.7
Martin, MN	269.4
Hardin, IA	235.4
Hamilton, IA	233.1
Blue Earth, MN	224.4

Does not include counties withheld to avoid disclosing individual data.
Source: USDA NASS, 2012 Census of Agriculture.

The Lower Cape Fear River Basin

The Cape Fear River originally earned its name from the treacherous, rocky passageways connecting the river to the Atlantic Ocean, but runoff and nitrogenous deposition from industrial animal operations are now the water's most ominous threat.[lxxxiii] North Carolina is leading the shift towards larger sized animal feeding operations, especially industrial hog operations.[lxxxiv] Following national consolidation trends, from 1997 to 2007 the size of hog operations in this region grew by over 45 percent.[lxxxv] North Carolina is also a leading state in the national production of turkeys and other poultry.[lxxxvi] Today, farm animals outnumber people by more
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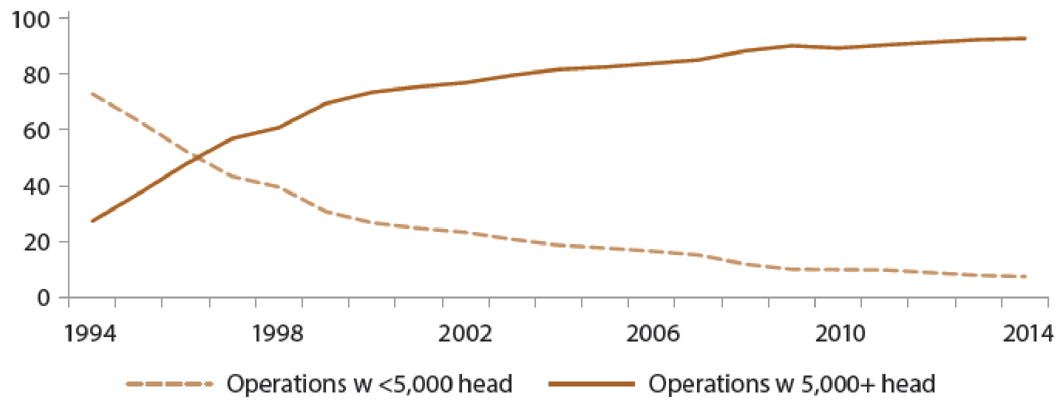
than 1,000 to 1, with animal agriculture in the Lower Cape Fear area alone producing an estimate of over 40 billion pounds of farm animal waste a year.

Fig. 7. Share of Annual Pig Crop by Size of Operation, 1994 - 2014 (percent)



Source: USDA NASS.

To dispose of such an enormous amount of waste, hog operations typically rely on open waste impoundment and field spraying systems, colloquially referred to as "lagoon and sprayfield" systems. These systems are highly susceptible to regular discharges into tributaries of the Cape Fear River system, including through seepage, leaking, and spills from waste impoundments; runoff from agricultural fields where the waste spread; and seepage into the area's high groundwater table. [lxxxvii] Nitrogenous deposition into waterways from the constant release of ammonia air pollution from these operations also increases water pollution and susceptibility to eutrophic conditions and dead zones. [lxxxviii]

In addition to pervasive systemic problems, there is also the looming threat of intentional or unintentional pollution discharge by operators who find themselves overwhelmed by hog waste. Spills and other catastrophic failures of industrial waste management systems as a result of severe weather events such as hurricanes are a predictable seasonal threat in this region.[lxxxix] In October 2016, for example, flooding from Hurricane Matthew overtook the region, leading an estimated 2 million confined chickens and at least 4,800 confined pigs to drown in the floodwaters, and untold quantities of industrial animal waste to spill into the state's waterways.[xc] Similarly, during Hurricane Fran in 1996, 22 animal waste pits in the state were reportedly ruptured or overflowed; at least one major manure spill was reported following Hurricane Bonnie in 1998; and after Hurricane Floyd dumped as much as 20 inches of rain across the region in 1999, animal-waste lagoons overflowed directly into waterways and surrounding communities.[xci] Due to climate change, the frequency of such storm events is expected to increase and intensify.

Table 2-5. Top ten states with the highest manure generation in 2007 on a farmland area basis.

National Rank	State	Estimated Tons Manure/Acre Farmland*
1	NORTH CAROLINA	3.85
2	DELAWARE	3.81
3	VERMONT	3.05
4	PENNSYLVANIA	2.99
5	WISCONSIN	2.80
6	CALIFORNIA	2.70
7	NEW YORK	2.66
8	MARYLAND	2.23
9	VIRGINIA	2.22
10	IOWA	2.22

** Refer to Appendix 1 for further description on livestock manure generation calculations. Reference: USDA 2009a.*

Profiles of Imperiled Species

A. Atlantic Sturgeon *(Acipenser oxyrinchus oxyrinchus)*
Status: Endangered

Atlantic sturgeon are old fish, both as a species and individually; the family of fish to which the Atlantic sturgeon belongs is one of the oldest, having been around since the time of the dinosaurs, and an individual sturgeon can live up to 60 years. Atlantic sturgeon live mainly in saltwater, but migrate into freshwater rivers and streams to spawn. It is here that they are more vulnerable to pollution from industrial animal agriculture. In 2012, the National Marine Fisheries Service (NMFS) listed the Carolina and South Atlantic distinct population segments (DPSs) of the Atlantic Sturgeon as endangered.[xcii] Within the Carolina DPS, the Cape Fear River is one of only four locations where the Atlantic sturgeon's subpopulation are believed to spawn, and its imperilment has been linked directly to industrial animal agricultural production in the area, particularly along the coastal portion of the Cape Fear River Basin.[xciii] Degraded water quality "contribut[es] to their endangered status by modifying and curtailing the extent of available habitat for spawning and nursery areas," and directly affects their ability to survive in the waters by lowering dissolved oxygen levels, causing not only oxygen depletion but also eutrophication and algae growth.[xciv] Without action these incredible boney fish could disappear from the region.

B. Wood Stork *(Mycteria americana)*
Status: Threatened

Standing three feet tall and with a wingspan of five feet, wood storks are large, graceful wading birds that often forage in shallow water tosnack on fish, frogs, and large insects. When prey touches the wood stork's submerged beak, it will quickly respond, reflexively snapping its beak shut within approximately 25 milliseconds. This remarkable feeding mechanism relies on healthy prey being found in high abundance.[xcv] Industrial animal agriculture affects this cycle by degrading water quality, resulting in reductions of fish and frog populations as a result of eutrophication and reduced biological oxygen demand.[xcvi] Further, pharmaceutical residues from industrial animal waste may affect the aquatic species on which wood storks rely. A recent study found that when minnows (an important part of the wood stork's diet) are exposed to endocrine disrupting pharmaceuticals, their hormonal balance is disrupted, potentially affecting health and disease transmission. [xcvii]

C. West Indian Manatee *(Trichechus manatus)*
Status: Endangered

With their large size, slow-moving nature, and fondness for munching on billowing sea grass, it's easy to see why manatees have been nicknamed "sea cows." As a species, they are curious and kind, and with their warm nature is often listed as a favorite by adults and children alike. For the Florida Manatee, its migration range includes not only Florida, but also North Carolina and the Cape Fear River.[xcviii] While the manatee has no natural predators in North Carolina or elsewhere, it faces daily peril from a barrage of manmade threats, including collisions with boats, entanglement in fishing gear, pollution and other water quality degradation, loss of sea grass (the manatee's primary source of food), and increases in red tide algae and other toxic algal blooms.[xcix] Indeed, cyanobacteria and red tide algal blooms can be lethal to manatees.[c] Historically in the Cape Fear river the presence of toxic algal blooms has been exceedingly rare; however, as a results of increased eutrophication of the river from discharge of nutrient pollution into the river from industrial hog operations, those incidences are becoming much more frequent, with the incidence of unprecedented blooms in at least 2009, 2012, and 2014.[ci] For exposed manatees, these types of toxic blooms can further contribute to population stress and declines.[cii] In addition, industrial animal operations contribute to climate change, which further impairs manatee recovery by changing water temperature, offsetting the manatee's equilibrium, and contributing to further sea grass loss.

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Endangered and Threatened Wildlife in Sampson, Bladen, Duplin, Pender Counties, NC: Wood Stork, Red-cockaded Woodpecker, Shortnose Sturgeon, Atlantic Sturgeon, Red Knot, Piping Plover, Loggerhead Sea Turtle, Leatherback Sea Turtle, Hawksbill Sea Turtle, West Indian Manatee, American Alligator, Northern Long-Eared Bat
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#3 North Central Iowa

Counties: Hamilton, Hardin, Wright, Franklin (Population 55,625; Farm Animal Population: 9,911,772)

Pounds of Poop Produced Annually by Human Population: 10,151,563

Pounds of Poop Produced Annually by Animal Agriculture: 18,631,231,760
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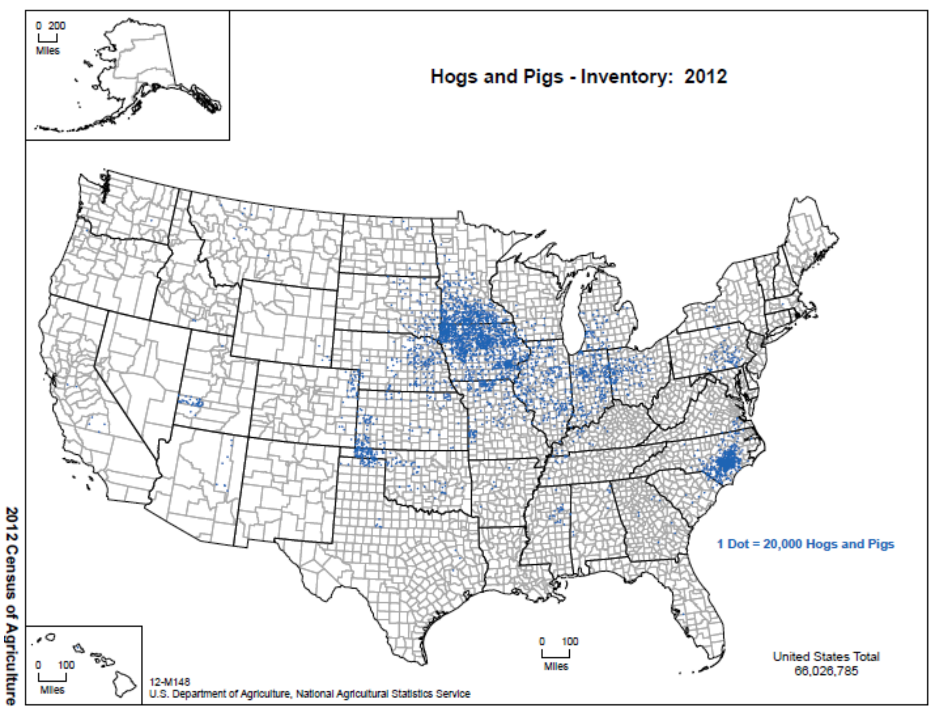
The Iowa Heartland

Iowa is the epicenter of hog production in the United States. In 2012 alone, the total hog inventory in the State of Iowa was over 20 million hogs, up from just under 13 million in 1987.[ciii] Despite this extreme thirty year growth in hog population, during that same time period the number of hog farms in the state fell drastically from 38,638 hog operations in 1987 to a mere 6,266 operations in 2012, with just 1,040 of those remaining operations in 2012 housing 2/3 - or approximately 12.7 million - of those populations. Taken another way, on average the number of hogs per operation has essentially jumped from roughly 300 per operation in 1987 to over 12 thousand per operation by 2012.[civ]



Such extreme concentration means that the remaining hog operations in the state manage an ever-increasing number of pigs, meaning that there are now more pigs in a single location than ever before. And these huge population numbers translate into gigantic concentrations of industrial animal waste. In just four north central Iowa counties of Hamilton, Hardin, Wright,
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and Franklin, hogs produce a shocking 17.4 billion of the 18.6 billion pounds of waste produced by farm animals in this area annually, or approximately 48 million pounds of hog waste per day.

Air pollution, water quality impairment, and depreciation in the health and welfare of the rural residents has accompanied the explosion of large industrial hog operations in the state.[cv] For example, as it relates to water quality impairment, in 2015 the Board of Water Works Trustees of the City of Des Moines, Iowa filed a Clean Water Act lawsuit because nitrate pollution from hog operations and other agricultural operations had severely impaired the Raccoon River, tainting the drinking water for the City of Des Moines and approximately half a million Iowans.[cvi]

Further, in assessing the effects of air pollution from these operations, a comprehensive report from Iowa State University and the University of Iowa found that the state's industrial animal feeding operations release a significant amount of hazardous air pollution, including 25 percent of the state's methane emissions and 10-15 percent of all of the state's greenhouse gas emissions.[cvii] The report, which we would recommend flipping through, reviews the myriad harms associated with the air pollution from these operations, including harms to public health, aquatic environments, wildlife, and tourism.[cviii]

Profiles of Imperiled Species

A. **Monarch Butterfly *(Danaus plexippus plexippus)***

Status: Petitioned for listing, and has received a positive 90 day finding[cix]

The multigenerational migration of monarch butterflies – a journey of more than 2,000 miles from Mexico to Canada, undertaken by animals weighing less than a single gram – is one of the great wonders of nature. A key portion of the monarch's migration range is the midwestern "Corn Belt," including Iowa. Over the past two decades, the monarch population has been in a freefall, declining more than 80 percent, with the last two winters bringing the lowest populations sizes ever recorded.[cx] Habitat fragmentation, pesticide use by agricultural operations, and climate change are primary threats to the monarch and its habitat, and are each directly and indirectly driven by industrial animal agricultural production.

Despite the monarch's ability to overcome incredible challenges on its migratory route, they are very particular about one thing: where they will lay their eggs. Monarch butterflies only lay their eggs on milkweed plants. However, this once common weed has been disappearing from Midwest agricultural fields because of, in large part, massive increases in the use of glyphosate - an herbicide more commonly known as Monsanto's Roundup. Herbicide-resistant varieties of crops such as corn and soy now comprise the vast majority of animal feed stock, with 93 percent of soybeans and 85 percent of all corn grown in the United States in 2013 genetically modified to resist herbicides.[cxi] Between 1995, the year before Roundup Ready soybeans were introduced, and 2013, total glyphosate use on corn and soybeans rose from 10 million to 205 million pounds per year, a 20-fold increase.

Glyphosate is a potent killer of milkweed and its heavy use has caused a precipitous decline of common milkweed populations, which has resulted in a corresponding drop in monarch population numbers.[cxii] What do corn and soy have to do with factory farms? An estimated 98 percent of U.S. soy meal, one of the two major products derived from commercially harvested soybeans, and just under 40 percent of U.S. corn, plus spent corn grains left over from ethanol production, is used to feed industrially farmed cattle, pigs, and chickens.[cxiii] In addition to the devastating impacts of these types of intensive cropping practices on the environment and species, that amount of grain is enough to feed between 800 million and 4 billion additional people, a monumental misuse in light of current food-insecurity concerns.[cxiv] So, while, to our knowledge, monarch populations are not yet drowning in the seas of animal waste being produced by Iowa's factory farms; they are suffocating under its harmful reliance on glyphosate-drenched corn and soy commodity crops.

B. Topeka Shiner *(Notropis topeka)*
Status: Endangered

The Topeka shiner is a small, silvery Midwestern minnow first listed as endangered in 1998.[cxv] The shiner relies on small prairie streams with good water quality and cool temperatures for its survival, making stability of these streams an essential aspect of the tiny fish's continued existence.[cxvi] The shiner is now understood to occupy less than 10 percent of its historic geographic range.[cxvii] In Iowa, much of that remaining range is in watersheds shared with industrial animal agricultural, including the Boone River, a tributary of the Des Moines River, and the Raccoon River, which have suffered severe nitrate pollution.[cxviii] This is of great concern for the remaining shiner populations because, according to the U.S. Fish and Wildlife Service, "[t]he action most likely impacting the species to the greatest degree in the past is sedimentation and eutrophication ... resulting from intensive agricultural development .... Feedlot operations on or near streams are also known to impact prairie fishes due to organic input resulting in eutrophication."[cxix] Continued discharge of ammonia, nitrate, nitrite, and other nutrient pollution (such as result from the decomposition of animal wastes) from industrial animal feeding operations into the shiner's remaining habitat is leading the Topeka shiner towards extinction.

C. Northern Long-Eared Bat *(Myotis septentrionalis)*
Status: Threatened

The northern long-eared bat – distinguishable from its close relatives, as one might presume, by its long ears – is a small insectivorous bat associated with forest environments. With a wingspan of approximately 9 inches and a total length of about 3.7 inches, this little bat ranges from the eastern to north central Unites states, and up to Canada. Much like other bats, the northern long-eared bat serves numerous important ecological functions, one of which - insect control - can often play a starring role in an organic farm or community's pest management strategy. However, in relying on insects like flies and moths for their diet, the northern long-eared bat is susceptible to threats that face the insects on which they survive. Scientific research shows that flies from or near industrial animal operations can carry contaminants such as pathogens or antibiotic resistant bacteria, which the insect may pass on to its predator.[cxx] This incidence is compounded by the fact that industrial animal feeding operations and especially the animal waste products they generate are breeding grounds for insects.[cxxi]

Further, as discussed in relation to the Monarch butterfly, use of pesticides and insecticides - both of which are used on the row crops that sustain the industrial animal production model and as used on the operations themselves, as well as habitat conversion and encroachment concerns have been identified as having a likely or potential negative impact to the northern long-eared bat.[cxxii] For a species facing such brutal impacts, with declines already up to 99 percent of the population in several eastern states, any additional stress to survival could prove to be calamitous.

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Endangered and Threatened Wildlife in Hamilton, Hardin, Wright, Franklin Counties, IA: Monarch Butterfly, Topeka Shiner, Northern Long-eared Bat

#4 The Susquehanna River Valley, Pennsylvania

Counties: Lancaster (Human Population: 536,624; Farm Animal Population: 21,200,262)

Pounds of Poop Produced Annually by Human Population: 97,933,880
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Pounds of Poop Produced Annually by Animal Agriculture: 8,688,870,860

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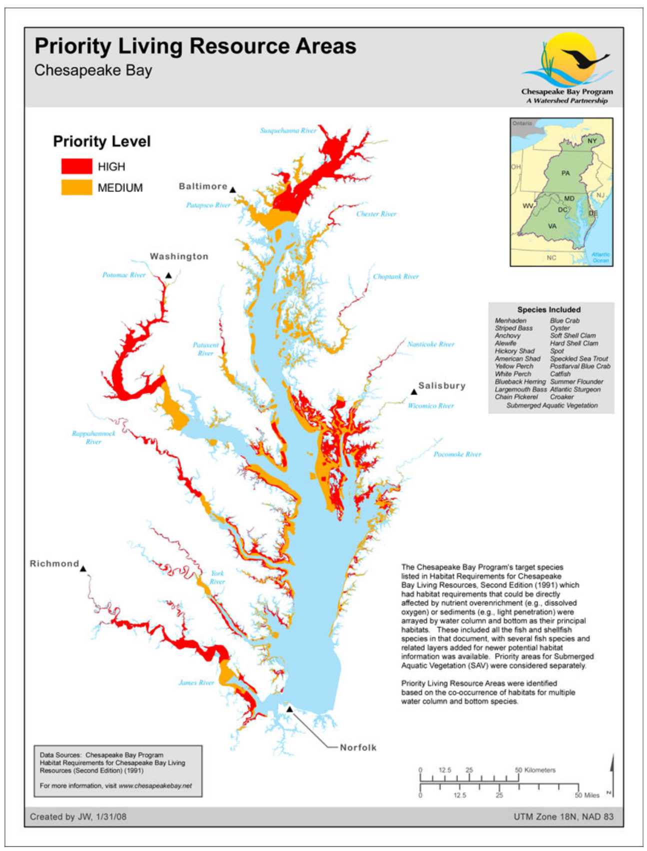
The Susquehanna River Valley

The Chesapeake Bay, considered one of this country's foremost national treasures, is a vital ecological and economic resource. Covering approximately 11,400 square kilometers from the mouth of the Susquehanna River to Virginia Beach (and draining approximately 165,800 square kilometers), the Chesapeake Bay is the largest estuary in the United States (and the third largest in the world).[cxxiii] The Chesapeake Bay is also home to more than 3,600 species of plants, fish, and animals, and is an important resting spot for migratory birds traveling along the Atlantic Flyway - with an estimated one million birds wintering in the Bay region each year. However, in the recent decades the Bay and its tributaries have been acutely degraded by anthropogenic pollution, including excessive loading of nutrients – including nitrogen and phosphorus – which have caused harmful algae blooms and negatively affected water quality.[cxxiv] Compounding the matter, the Bay is further estimated to have lost great swaths of its forested shorelines, wetlands, underwater sea grasses, and oyster populations as a result of development, sea level rise, pollution effects, and overharvesting - changes that have harmed many wildlife species including the threatened and endangered shortnose sturgeon, the Atlantic sturgeon, and all 5 species of sea turtles that frequent the Bay's waters.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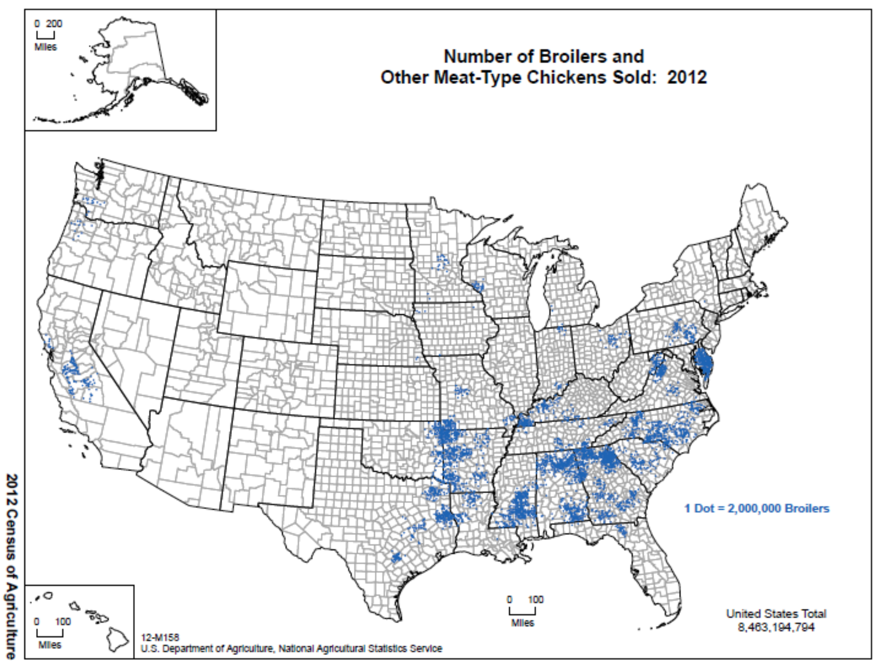
One of the major sources for this impairment is the Susquehanna River, which contributes one-half of the freshwater flow to the Bay – an average of about 19 million gallons of water per minute.[cxxv] The Susquehanna provides drinking water for more than six million people and is considered one of the nation's best smallmouth bass fisheries. Maintaining the health of the Susquehanna River is essential for preserving the biodiversity of the entire Chesapeake Bay region, both for permanent residential and migratory species.

While the Susquehanna River originates 444 miles north in Cooperstown, New York, it is Lancaster County, Pennsylvania - the last county in Pennsylvania to embrace the river before it flows into the Bay – that has a truly miraculous impact on the health of the Susquehanna and the Bay. Lancaster County has just over 21 million farmed animals (including cattle, swine, and poultry), which produce approximately 8.69 billion pounds of waste per year. According to the EPA, agriculture is the single largest source of nutrients to the Chesapeake Bay, accounting for 38 percent of nitrogen and 45 percent of phosphorus.[cxxvi] Seventeen percent of that nitrogen and 26 percent of the phosphorus is from farm animal waste (with an additional 6 percent of nitrogen classified as being from livestock, through avenues such as air pollution deposition, and "fertilized soil emissions").[cxxvii] EPA attributes these "significant nutrient imbalances and nutrient-related, local water quality impairments" to "[d]ensely populated animal agriculture operations," and their "[i]nconsistent implementation of sound nutrient management practices."[cxxviii]



In order to restore the productivity and biodiversity of this river system and the Bay to health, nitrogen and phosphorus loading must be reduced; to do so, continuing discharges of pollutants from industrial animal operations must be addressed.[cxxix]

Profiles of Imperiled Species

A. **Shortnose Sturgeon *(Acipenser breviorostrum)***
Status: Endangered

While currently 20 species of sturgeon exist throughout the Northern Hemisphere, only two species – the shortnose sturgeon and the Atlantic sturgeon – can be found on the Atlantic coast. The shortnose sturgeon is a primitive bony fish with a very distinctive, prehistoric appearance. The shortnose sturgeon, smaller than its Atlantic cousin, can grow up to 4 feet and 25 pounds.[cxxx] Known as "benthic" feeders, shortnose sturgeon use their snouts like vacuums to sift through the mud of low-salinity rivers, looking for clams, mollusks, crustaceans and insects to eat. The shortnose sturgeon formerly occupied rivers and estuaries along the Atlantic coast of the United States, and once provided an abundant and reliable source of food for early English settlers. However, the shortnose sturgeon was driven to near extinction by overfishing, by-catch in the shad fishery, damming of rivers, habitat destruction, and deterioration of water quality. Shortnose sturgeon are very sensitive to water quality, especially low oxygen levels, pollution, and other poor water conditions.[cxxxi] Water quality impairment owing to nutrient pollution from industrial animal operations is a stressor to the shortnose sturgeon, and threatens the recovery of the species.[cxxxii]

B. **Bog Turtle *(Clemmys muhlenbergii)***
Status: Threatened

Averaging only three to four inches long, the bog turtle is North America's smallest turtle. Bog turtles are semi-aquatic, and are known to inhabit shallow, spring-fed marshes, bogs, swamps, marshy meadows, and wetlands.[cxxxiii] Unfortunately for the bog turtle, its small, "cute" appearance has played a role in its decline, with bog turtles historically being targeted by the pet trade. The bog turtle is also under exceptional threat from the loss, degradation and fragmentation of its habitat, including from wetland alteration, pollution, and advanced plant growth. Today, since the bog turtle is considered one of the most rare freshwater turtles in America and protections for the turtle have expanded, the impacts on this turtle from the pet trade have subsided, but habitat impairment issues from agriculture remain, making Pennsylvania, and in particular the Susquehanna region, key to any hopes for species to recovery.[cxxxv] Specifically, the U.S. Fish and Wildlife Service has found that for the species to recover for the myriad threats it faces, the region must address and curb agricultural pollution, "conversion of wetlands to farm ponds, non-point source pollution, lack of buffers around wetlands, and hydrological impacts from residential development."[cxxxvi] If these threats are not quickly and meaningfully addressed, this tiny turtle may disappear forever.

C. **Maryland Darter *(Etheostoma sellare)***
Status: Endangered

The Maryland darter, related to the yellow perch and the walleye, is one of the rarest freshwater fish species in the world. The darter is also believed to be Maryland's only endemic vertebrate (meaning it is the only vertebrate of its type that lives only in the State of Maryland, while all other vertebrates species in the state have a range that extends beyond Maryland).[cxxxvii] As poetically described by the Maryland Department of Natural Resources, the darter "is a living museum piece: a survivor from a different, more pristine Maryland, before human influence changed the nature of the land forever." Specifically, the darter lives just downstream of Lancaster County in the Susquehanna watershed, and the main stem of the lower Susquehanna River has long been recognized as valuable for the recovery of the Maryland darter.[cxxxix] The darter is a bottom-dwelling fish that requires clean, well-oxygenated, swiftly flowing water bodies. One could say that the darter loves nothing more than a tumbling little rapid of fresh, clean water. Like other species of darters, the Maryland darter is sensitive to the effects of water quality degradation. Indeed, researchers worry that decreased population numbers are as a result of degradation of water quality - such as from nutrient pollution and other water quality impairment - in the Susquehanna River.[cxl]

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Endangered and Threatened Wildlife in Lancaster County and the headwaters of the Chesapeake Bay, PA/MD: Northern Long-eared Bat, Northeastern Beach Tiger Beetle, Indiana Bat, Bog Turtle, Shortnose Sturgeon, Maryland Darter, Chesapeake Logperch, Dwarf Wedgemussel, Bald Eagle[cxli]
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<u>**#5 The Delmarva Peninsula, Delaware**</u>

Counties: Sussex (Human Population: 215,622; Farm Animal Population: 35,501,514)

Pounds of Poop Produced Annually by Human Population: 39,351,015

Pounds of Poop Produced Annually by Animal Agriculture: 5,066,201,460
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The Delmarva Peninsula

Isolated between the Chesapeake Bay, Atlantic Coast, and Delaware Bay, the Delmarva Peninsula is "a place unto itself."[cxlii] The adjacent Delaware Bay "is the largest stop for shorebirds in the Atlantic Flyway and is the second largest staging site in North America. About 425,000 to 1,000,000 migratory shorebirds converge on the Delaware Bay to feed and build energy reserves prior in northward migration."[cxliii] On the Delmarva Peninsula, which contains most of Delaware as well as parts of Maryland and Virginia, agriculture covers about 48 percent of the land.[cxliv] Indeed, this area faces the double threat of industrial animal agriculture: both ample amounts of animal waste *and* pollution runoff from the row-crops (primarily soy and corn) that are grown primarily to feed the hundreds of millions of broiler chickens produced annually on the peninsula.[cxlv]

In the Delaware County of Sussex, animal agriculture produces over 5 billion pounds of farm animal waste a year. "Sussex County is the birthplace of the nation's broiler chicken industry and ranks #1 in the U.S. in broiler production with over 200 million birds produced each year."[cxlvi] Pollution from that waste impacts not only the Delaware Bay and the Atlantic, but flows through the Nanticoke River watershed from its headwaters in Sussex down to the Chesapeake Bay.

Top Counties: Poultry and Egg Sales ($ millions)	
Sussex, DE	657.5
Duplin, NC	522.7
Sampson, NC	499.8
Lancaster, PA	469.0
Rockingham, VA	460.6
Benton, AR	457.5
Shelby, TX	448.6
De Kalb, AL	411.1
Gonzales, TX	402.3
Merced, CA	400.5

Does not include counties withheld to avoid disclosing individual data.
Source: USDA NASS, 2012 Census of Agriculture.

Mostly due to nutrient discharge, runoff and other pollution events in Sussex County lead to extreme water quality impairment in much of Delaware, contributing to the 94 percent of rivers and streams and 74 percent of freshwater ponds and lakes in the state that do not fully support fish and wildlife uses, and 85 percent of rivers and streams and 41 percent of freshwater ponds and lakes in the state that do not fully support swimming uses.[cxlvii] Further, approximately 86 percent of Delaware's rivers and streams, 44 percent of its ponds and lakes, and 2 percent of its estuarine waters have bacteria concentrations that are so extreme that that state agencies recommend avoiding recreational contact with waters, with many of these waters also deemed unsafe for harvesting and consuming shellfish; industrial animal operations have been identified as "significant sources" for this bacteria.[cxlviii] Water quality monitoring has additionally
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established that 18 percent of domestic wells across the state exceeded the drinking water standard for nitrogen, and that oxygen levels in Delaware's streams, ponds, and bays are "often too low to fully support aquatic life."[cxlix] Accordingly, many of Delaware's surface waters are classified as impaired under the Clean Water Act.[cl]

In 2010, the EPA established a set of necessary science-based nitrogen and phosphorus pollution reduction limits that would enable the Bay-area states, including Delaware, to restore the Chesapeake Bay to health.[cli] Delaware's pollution reduction goals were set at 3.4 million pounds of nitrogen and 26.8 thousand pounds of phosphorus by 2025.[clii] However, Delaware is having difficulty meeting those pollution reduction goals because of continuing discharges of nitrogen and phosphorus from industrial animal operations.[cliii]

Wetlands health has also been impacted by industrial animal agricultural production on the Delmarva Peninsula. These effects are problematic because wetlands provide habitat for the diverse array of animals that are deeply dependant on these ecosystems.[cliv] In addition to impairment issues, the area has faced huge wetland area losses, predominantly caused by conversation to agricultural lands, which have lead to significant reductions in wetland functions.[clv]

Profiles of Imperiled Species

A. **Red Knot *(Calidris canutus rufa)***
Status: Threatened

Some impacts of animal agriculture on species are more obvious than others. Take the red knot, for example. This little shorebird travels over 9,000 miles on its epic migration from the tip of South America to Northern Canada. In the course of that massive migration, climate change, shoreline development, and changes to prey availability have all negatively impacted the red knot.[clvi] Indeed, when the red knot was listed as threatened in 2014, it became the first bird to be listed explicitly because it is threatened by climate change.[clvii]

In addition to threats from climate change the red knot also faces harm from the spread of avian influenza, which can be spread via industrial animal agriculture. Avian influenza - bird flu - is a deadly virus that infects wild birds (such as ducks, gulls and shorebirds) and domestic poultry (such as chickens, turkeys, ducks and geese).[clviii] Bird flu can spread across bird species between wild and domestic birds.[clix] Contact with infected fecal material is the most common pathway of bird–to–bird transmission.[clx] Studies suggest "waste from duck and chicken farms may spread to bodies of water via wind, surface runoff or possibly enter groundwater through disposal and composting of waste on poultry farms."[clxi] From 2014-2015, 211 commercial flocks were hit by a highly pathogenic version of bird flu, affecting over 50 million birds.[clxii] With a high commercial poultry population outbreaks of bird flu on the Delmarva Peninsula may further threaten the survival of the red knot.[clxiii]

B. **Green Sea Turtle *(Chelonia mydas)***

Status: Endangered (Florida and Mexico's Pacific coast breeding colonies); Threatened (all other areas)

Green sea turtles rely upon beaches around the Chesapeake Bay for critical nesting habitat. When they aren't migrating these turtles rely on shallow waters inside reefs, bays, and inlets. They are also attracted to lagoons and shoals that have an abundance of marine grass and algae. Green sea turtles are listed as endangered in Florida and Mexico's Pacific coast breeding colonies, and as threatened in all other areas - including the Mid-Atlantic. Green sea turtles face a number of threats, including illegal egg harvest, accidental capture in fishing gear, disease, and pollution.[clxiv] A further stressor to green sea turtle populations is a disease called fibropapillomatosis. Related to the herpes virus, fibropapillomatosis can cause potentially fatal tumors to grow on the eyes, intestinal track, lungs, mouth, and heart of affected turtles. [clxv] Studies have linked agricultural pollution and the spread and proliferation of fibropapillomatosis.[clxvi] Industrial animal agricultural runoff also contains heavy metals such as copper, which can be absorbed by marine algae and sea grasses, leading bioaccumulation of heavy metals in green sea turtles feeding on these grasses.[clxvii] Heavy metals that accumulate in a mother turtle can then be passed down to the egg, harming future populations.[clxviii] Climate change can also distress sea turtle populations through sea level rise, beach erosion, change to sea turtles' migration routes and nesting behaviors, and ocean acidification linked with parallel decreases in sea turtle prey populations.[clxix]

C. Delmarva Peninsula Fox Squirrel *(Sciurus niger cinereus)*

Status: Delisted in 2015, still in peril[clxx]

With its long, exceedingly fluffy tail, the Delmarva Peninsula fox squirrel is the largest variety of tree squirrel in North America. Originally listed as endangered in 1967, this shy gray squirrel is a native of the Delmarva Peninsula.[clxxi] By the time it was listed, the fox squirrel had already been reduced to about 10 percent of its historic range, due largely to logging, farming, and development. In 2015, after modest population gains and an expanded distribution from four counties to ten, the Fish & Wildlife Service elected to remove the Delmarva Peninsula fox squirrel from Endangered Species Act protections.[clxxii] Yet, this large fluffy squirrel remains in peril.

In 2012, an analysis by the Center concluded that these squirrels remain in *Deadly Waters* due to climate change induced sea level rise.[clxxiii] If climate change is not curbed, these fluffy squirrels face almost certain extinction. Climate change is contributing to sea level rise, which is drastically altering the coastline along the Chesapeake and Delaware Bays. Estimates predict that sea level may rise up to six feet within this century and such a drastic change will overwhelm the fox squirrel's habitat by eliminating approximately half of the habitat it currently occupies.[clxxiv] This large loss of habitat would pose a significant threat to continued survival.

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Endangered and Threatened Wildlife in Sussex County and the Chesapeake Bay, DE/VA: Red Knot, Piping Plover, Leatherback Sea Turtle, Hawksbill Sea Turtle, Green Sea Turtle, Delmarva Peninsula Fox Squirrel

#6 The Oklahoma Panhandle

Counties: Texas (Human Population: 21,489; Farm Animal Population: 1,205,031)

Pounds of Poop Produced Annually by Human Population: 3,921,742.5

Pounds of Poop Produced Annually by Animal Agriculture: 8,730,249,870

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The Oklahoma Panhandle

Located in Oklahoma's Panhandle, Texas County is a part of the America Great Plains region, the world-renowned home to diverse ecology and abundant wildlife, including the endangered and majestic Whooping Crane, Arkansas River Shiner, and the unforgettable Lesser Prairie Chicken.

In the 1930's, the Panhandle rose to historic prominence as the center of the Dust Bowl, a symbol of the devastation of the American Great Depression.[clxxv] This piece of the Panhandle's past is steeped not only in historic significance, but also agricultural significance. Originally covered with grasses that secured the area's fine soils, settlers exhausted the topsoil through agricultural practices, including the overplanting of wheat and overgrazing of cattle and sheep herds.[clxxvi] When the historic droughts hit the exhausted topsoil, “the land just blew away in the wind.”[clxxvii] As summarized by prominent historian Robert Worster, the significance of “the dust storms of the 1930s was that America as a whole, not just the plains, was badly out of balance with its natural environment.”[clxxviii]

Unfortunately, with Oklahoma's Panhandle now brimming with industrial animal agriculture, an imbalance continues to plagues the region. Over the past few decades the number of hogs in the Panhandle has more than doubled, with Texas County rising to number three on the list of America's Top 100 Pig Counties (just behind Duplin and Sampson Counties in North Carolina).[clxxix] Once covered by rich prairies and great biodiversity, the Panhandle is now home to approximately 1.1 million swine, which produce over 8.7 billion pounds of manure each year - or as much waste as the sewage from all of the residents of the NY metropolitan area.[clxxx]

The extent of the harm of these operations to native species and habitat is incalculable. In addition to threats to air and water quality, this area faces relentless habitat destruction and fragmentation due to the growth of industrial hog farms and the commodity cropping industry on which they rely. As described by Oklahoma's Kerr Center for Sustainable Agriculture, "[a]s the hog corporations look for more places to locate their operations, they look to rural areas such as Texas County where land is cheap. The rural locations often offer looser enforcement of
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environmental standards, cheaper labor, tax breaks, subsidized energy, water and sewage and construction of the supportive infrastructure."[clxxxi]

Indeed, in 2014 alone the Great Plains region lost more grasslands to agricultural conversion than the Brazilian Amazon lost to deforestation.[clxxxii] Since 2009, experts estimate that this loss adds up to a staggering 53 million acres of grassland and other sensitive habitat in the Great Plains being converted to cropland, including corn and soy.[clxxxiii] These types of land-use changes not only consume habitat vital to the survival of endangered and threatened species, but also contribute to erosion and increased greenhouse gas emissions by releasing carbon dioxide previously stored in the soil and grasses.[clxxxiv] The consequences of this growth and regulatory blindfold are dire for wildlife.

Profiles of Imperiled Species

A. Whooping Crane *(Grus americana)*
Status: Endangered

The majestic whooping crane embodies the struggle for conservation and preservation of imperiled wildlife in this country. First listed as endangered in 1967, the whooping crane remains today one of the rarest birds in North America despite decades of heroic dedication to its recovery. [a few sentences about this, the planes that attempted to teach them to fly their migratory route again, the handlers dressed as cranes, etc)

Whooping cranes pass through the Oklahoma Panhandle each spring and fall during migration. Up from a historic low of just fifteen known birds in the early 1940's,[clxxxv] the current migratory population estimated at only approximately 270 birds.[clxxxvi] Oklahoma's Salt Plains National Wildlife Refuge is the one of the most frequently used fall whooping crane stopover sites, and is essential to maintaining and growing the population of this critically endangered species.[clxxxvii] The Salt Plains National Wildlife Refuge, situated just east of Texas County, has been the subject of significant investigation regarding impacts to the refuge from industrial animal agriculture. In 2004, researchers with the USGS National Wildlife Health Center found a concerning array of "[m]ajor agricultural pollutants includ[ing] bacterial pathogens and nutrients that originate from animal wastes"[clxxxviii] associated with several industrial animal agriculture facilities near the Salt Plains National Wildlife Refuge. Downstream sampling identified bacterial indicators of fecal contamination that exceeding the EPA's water quality limits, and a subset were found to be resistant to antibiotics commonly administered to livestock.[clxxxix] These pollutants degrade habitat and create potential harm to migratory whooping cranes. Manure ponds also pose a threat to cranes fatigued from their long migration could actually land in a lagoon filled with animal waste is omnipresent.

B. Arkansas River Shiner *(Notropis girardi)*
Status: Threatened

The Arkansas River Shiner is a minnow with a small body and a quick pace. Originally listed as threatened in 1998, the shiner is already believed to have become extinct in its namesake state, Arkansas. It is also believed to have disappeared from more than 80 percent of its historical range, and less than half of the area that is "essential" to keeping it from extinction. [cxc] Within the "essential" shiner habitat *not* yet granted federal protections is Oklahoma's Beaver/North Canadian River, which runs directly through the heart of hog waste-rich Texas County.[cxci] Maintaining the health and quality of the Beaver/North Canadian River is critical to the shiner's recovery, as imperilment from degraded water quality is one of the top threats the shiner faces. [cxcii] The Fish and Wildlife Service's decision to exclude the Beaver/North Canadian River from the shiner's designated critical habitat coupled with the extreme threat the river faces every day due to surrounding industrial animal agricultural operations makes it highly likely that, without systemic change, this little fish is going to continue to experience further reductions and population losses. These concerns were again confirmed in 2003 when a large discharge of livestock waste into the Canadian River caused the death of an estimated 11,000 Arkansas River Shiners.[cxciii] In the Beaver River Watershed, there are at least 55 permitted industrial animal feeding operations,[cxciv] and the river is already listed under the Clean Water Act as impaired for pathogen, dissolved oxygen, and turbidity - all of which can negatively impact the health of the shiner.[cxcv] If the shiner is going to survive, industrial animal operations in this watershed must clean up their acts.

C. Lesser Prairie-Chicken *(Tympanuchus pallidicinctus)*

Status: Delisted, still critically imperiled[cxcvi]

The lesser prairie-chicken - an icon of the Southern Plains - is a large, ground-nesting bird that inhabits shortgrass prairies, sand sage grasslands, and shinnery oak shrubsteppe across eastern New Mexico, the Texas panhandle, Oklahoma, Kansas and southeastern Colorado. Each spring, prairie-chickens gather at traditional breeding sites called "leks" where males perform elaborate dances, display their colorful plumage and mating songs, and compete for the right to breed with females. These leks are also the hub of nesting activity and are just one of the many fascinating and unique characteristics of this charismatic little grouse.

Protected as a threatened species under the Endangered Species Act in 2014, the lesser prairie-chicken was removed from the Federal List of Endangered and Threatened Wildlife in 2016 despite strong scientific evidence showing that this bird is still very much in danger of further species decline and potential extinction.[cxcvii] In response to an emergency listing petition from the Center and its partners, the FWS is in the process of re-assessing the prairie-chicken's listing status.[cxcviii]

The lesser prairie-chicken is believed to have already been displaced from approximately 85 percent of its historic range.[cxcix] In the prairie-chicken's sand sage prairie distinct population segment, which includes the Oklahoma panhandle, prairie-chicken populations were once among the highest in the range, but, as of 2014, those population numbers had dipped to fewer than 500 birds over almost 4 million acres.[cc] A primary factor supporting the decision to protect the lesser prairie-chicken as an endangered species was habitat loss and fragmentation as a result of conversion of grasslands to agricultural uses, along with conversion for energy development and invasive species encroachment.[cci] Industrial animal agriculture is in the thick of this decline, specifically in fueling habitat conversion to cropland.[ccii] Nationally, of the over 23 million acres of grasslands, shrub land, and wetlands converted to agricultural land between 2008 and 2011, more than 8.4 million were converted to plant corn and more than 5.6 million were converted to plant soy - two crops that are essential to the industrial animal agricultural model.[cciii] For the lesser prairie chicken in Texas County, OK, this was equal to a conversion of more than 50,000 habitat acres to cropland during that time period, much of which was converted for the purpose of growing corn.[cciv]

Numerous studies have also shown that continuous nitrogen deposition - including as a result of ammonia from industrially raised farm animals and their waste products - can have damaging effects on the grasslands upon which the prairie-chicken relies.[ccv] With lesser prairie-chicken populations continuing to decline and habitat dwindling to dangerous levels, these unique birds desperately need to have their habitat protected from industrial animal agriculture operations and the mountains of dangerous waste they produce.

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Endangered and Threatened Wildlife in Texas County, OK: Whooping Crane, Red Knot, Piping Plover, Lesser Prairie-Chicken, Arkansas River Shiner
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#7 The Ozarks, Arkansas

Counties: Washington, Benton, Carroll (Human Population: 502,853; Farm Animal Population: 48,327,675)

Pounds of Poop Produced Annually by Human Population: 91,770,673

Pounds of Poop Produced Annually by Animal Agriculture: 10,673,991,820
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The Ozarks

The southeast United States is a place of unparalleled aquatic biodiversity, including 493 fishes (62 percent of U.S. fish species), at least 269 mussels (91 percent of U.S. mussel species), and 241 dragonflies and damselflies (48 percent of all those in North America).[ccvi] The Southeast also contains more than two-thirds of North America's species and subspecies of crayfishes and more amphibians and aquatic reptiles than any other region. It has some of the richest aquatic fauna of any temperate area in the world, rivaling the tropics in its diversity. Unfortunately, the Southeast's staggering variety of freshwater life forms and their habitat are also in one of the most imperiled ecosystems on the planet. Thanks to pollution, development, logging, poor agricultural practices, dams, mining, invasive species and other threats, extinction is looming for more than 28 percent of the region's fishes, 48 percent of its crayfishes and 70 percent of its mussels.[ccvii]

In Arkansas, industrial animal operations reigns in terms of pollution potential, with its chicken farms producing the same amount of waste each day as eight million people - or almost three times the human population of the entire state of Arkansas.[ccviii] Animal operations in the northernmost section of the Ozark region alone produce more than 10 billion pounds of waste annually, mostly from poultry and cattle operations. In particular, Washington County leads the state in broiler chicken production, followed by Benton County, with egg production and turkey production also concentrated in the northwest corner of the state.
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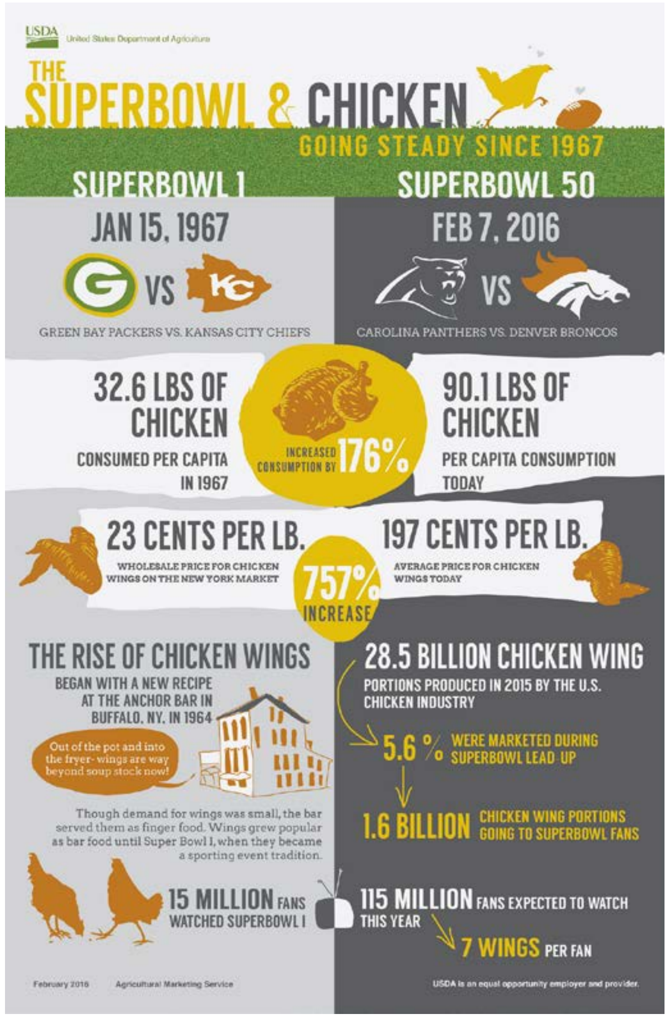

These millions of farm animals and their waste are situated on northeast Arkansas's mantled karst system, which means that a majority of these operations are sitting on top of Mississippi-aged carbonate rocks that create a porous underground drainage system that lends to the transportation of the animal waste products that are spread onto land into groundwater sources and connected hydrologic features. [ccix] As a result, farm animal waste contamination of groundwater, with discharges into surface water via seeps and springs, is a "primary concern for the area."[ccx]

It's no surprise, then, that the EPA considers the Arkansas-Oklahoma border to be a particular "area of concern." [ccxi] EPA officials have identified numerous water bodies in northwest Arkansas and northeast Oklahoma that have been impaired by manure from animal feeding operations and have also expressed concern regarding their role in polluting groundwater in the area. [ccxii] Indeed, according to Arkansas' 2004 Integrated Water Quality Monitoring and Assessment Report, the waste generated from animal production facilities in northwest Arkansas is generally applied to land and has the potential for contaminating both surface and ground waters. [ccxiii] "The nutrient levels measured from this region are atypically high and are trending upward."[ccxiv] Animal feedlots are listed as not only a source of impairment for surface waters in the state, but also as one of the "[t]en highest priority sources" for groundwater contamination.[ccxv]

Profiles of Imperiled Species

A. Neosho Mucket *(Lampsilis rafinesqueana)*
Status: Endangered

The Neosho Mucket is a freshwater mussel found in rivers and streams in Arkansas, Kansas, Missouri, and Oklahoma. The health of the Neosho mucket is a good indication of water quality in the water system, so guaranteeing the health of mussel populations by protecting mussel habitat ultimately means ensuring clean water for everyone in the watershed. By feeding on algae and plankton, mussels also serve as natural water filters.[ccxvi] Unfortunately, the mucket's population has been in continued decline since it was listed as endangered in 2013, with water quality degradation and habitat loss named as the primary causes of its trouble.[ccxvii] Studies indicate it is likely that pesticides and water pollution, including from industrial animal operations, has played a large role in shrinking population sizes.[ccxviii] Erosion from lands where industrial animal waste has been applied has also been linked to sedimentation in waterways[ccxix], which can negatively impact the Neosho mucket by suffocating the little bivalve.[ccxx] Increased sediment levels may also make it difficult for mussels to feed, which can lead to decreased growth, reproduction, and survival. Freshwater mussels are impacted by chronic, low level exposure to heavy metals, specifically copper and zinc, components of runoff from some industrial animal operations.[ccxxi] In addition, ammonia is particularly toxic to early life stages of mussels, and industrial animal agriculture operations are a major source of ammonia, both into the air and dissolved into waters.[ccxxii]

B. Rabbitsfoot Mussel *(Quadrula cylindrica)*
Status: Threatened

The rabbitsfoot mussel is another incredible freshwater mussel. Also found in the Ozarks, the rabbitsfoot mussel can grow up to six inches in length and is identified by a rectangular, olive shell featuring distinct black triangles on the outside and iridescent purple or white inside. Adult mussels are filter feeders, consuming primarily organic detritus from the water column. Riding a parallel trajectory to the mucket, the rabbitsfoot mussel has disappeared from 64 percent of its historic range, has experienced a long-term decline of up to 90 percent, and continues to decline very rapidly.[ccxxiii] The rabbitsfoot is threatened by, among other things, water pollution, sedimentation, pesticides - all impairments that are associated with industrial animal production.[ccxxiv] For this mussel, the effects of contaminants on juvenile mussels are especially acute.[ccxxv] The southeastern United States has already lost more than 50 mollusk species to extinction, and 70 percent of the remaining species are at risk of disappearing without further protection and water quality improvement.[ccxxvi]

C. Cave Crayfish *(Cambarus aculabrum)*
Status: Endangered

The cave crayfish is a small, endangered crayfish with a complete lack of pigment that - in addition to a limited range in Missouri - is found in only two caves in Arkansas.[ccxxvii] "With such a limited range, any activity that would destroy or adversely modify either of these caves' habitats would also jeopardize the continued existence of the species."[ccxxviii] Despite the extreme need to protect this little critter and its restricted critical habitat from all threats to protect against extinction, the deleterious effect of industrial animal agriculture on the cave crayfish in at least one of those two caves is well understood and remains virtually unrestrained.[ccxxix] Specifically, management and disposal of poultry, swine, and cattle waste within the recharge area of the cave crayfish's habitat have been linked to degraded environmental conditions, with nutrients and heavy metals established as major pollutants of this ecosystem.[ccxxx] Resultantly, water quality degradation is the number one limiting factor to cave crayfish populations, with groundwater pollution as a primary source for concern.[ccxxxi] To sustain (and, essentially, recover) cave crayfish populations, it is necessary to reduce pollution from industrial animal operations into the groundwater basin and stop their devastation of the habitat on which the crayfish relies.

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Endangered and Threatened Wildlife in Washington, Benton, Carroll Counties, AR: Northern Long-eared Bat, Rabbitsfoot Mussel, Piping Plover, Ozark Big-eared Bat, Neosho Mucket, Indiana Bat, Gray Bat, Southern Cave Crayfish, Scaleshell Mussel, Ozark Cavefish
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#8 The Snake River Watershed, Idaho

Counties: Twin Falls, Gooding, Jerome (Human Population: 120,473; Farm Animal Population: 368,437)

Pounds of Poop Produced Annually by Human Population: 21,986,323

Pounds of Poop Produced Annually by Animal Agriculture: 10,425,073,060

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The Snake River Watershed

The Snake River, often referred to as "one of the most important streams in the Pacific Northwest section of the United States,"[ccxxxii] is believed to have acquired its name from early European explorers "who misinterpreted the sign made by the Shoshone people who identified themselves in sign language by moving the hand in a swimming motion which appeared to these explorers to be a 'snake.'" Signifying the importance of aquatic life to the river and the region, this Shoshone sign actually translates to "river with many fish," a name that will forever tragically underscore the importance of the Snake River for its biological and ecological complexity.

Ranking third in the nation for total dairy cows, Idaho is also home to one of the country's largest and most consolidated dairy industries.[ccxxxvi] In particular, in 1997, the state's dairy industry surpassed the income from Idaho's famous potato industry, and then came back in 1998 to outpace both the potato and beef industries.[ccxxxvii] In particular, from 2007 and 2012 the number of dairy cows in the state ballooned to more than 45,000 cows, while the average dairy facility size grew by nearly 25 percent.[ccxxxviii] At the same time, accompanying this growth in animal numbers and concentration, the number of dairy operations in the state were shrinking, with many of the state's smaller operations being replaced by megadairies.[ccxxxix]

Idaho's current generation of megadairies are a real problem for the Snake River watershed and the wildlife and communities that rely on the watershed's continuing health and vitality. The Middle Snake River Watershed and, specifically an area known as the "Magic Valley" - or, as the Idaho Concerned Area Residents for the Environment has named it, "Excrement Alley" - is at the center of this concern.[ccxl] The Middle Snake River is home to numerous endangered species, including the Bliss Rapids Snail, the Banbury Springs Limpet, and the Snake River Phyla Snail. Each of these species has its own unique and important role to play in maintaining the exceptional biodiversity in this region. However, industrial animal agriculture is threatening the health of these species and the communities who share this wild place.

Idaho's dairy industry has also recently been at the center of legislative efforts to shield any information about the inner workings of its dairy operations from the public's view. Idaho's law, referred to colloquially as an "Ag Gag" law, makes it a crime for a private citizen to document animal welfare, worker safety, and food safety violations at an "agricultural production facility"
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(thus "gagging" speech that is critical of industrial agriculture). The Center, along with Food & Water Watch, is part of a large coalition in arguing that this Idaho law is unconstitutional.

Profiles of Imperiled Species

A. **Bliss Rapids Snail *(Taylorconcha serpenticola)***
Status: Threatened

The Bliss Rapids snail is a small mollusk that lives in the cold springs and spring-influenced waterways along the Snake River in southern Idaho. Groundwater depletion and degraded water quality are major and ongoing threats to this species' health.[ccxli] Indeed, the U.S. Fish and Wildlife Service clearly confirmed at the time it listed the Bliss Rapids snail that it ''require[s] cold, well-oxygenated unpolluted water for survival. Any factor that leads to deterioration in water quality would likely extirpate [the Bliss Rapids snail].''[ccxlii] FWS has identified dairies and feedlots as an important contributor to water quality decline in the Snake River,[ccxliii] the snail's principal habitat[ccxliv].

Further, groundwater quality plays a vital role in securing the future of the Bliss Rapids snail. These snails are dependent on spring outflows in their principle habitat, making them highly vulnerable to changes in groundwater quality and levels.[ccxlv] According to the Idaho Department of Environmental Quality (IDEQ), "dairy and feedlot practices" are a major source of nitrate contamination in this region, contributing to nearly 90 percent of the wells in one sample area displaying nitrate concentration greater than the contaminant limit for safe drinking water.[ccxlvi] The groundwater in this region empties into the Eastern Snake River Plain Aquifer and, ultimately, into the Snake River itself, the only place where this tiny, threatened snail is found.[ccxlvii] The Eastern Snake River Plain is also the sole source of drinking water for nearly 300,000 residents of eastern Idaho,[ccxlviii] making the health of the community inextricably intertwined with the fate of this tiny imperiled snail.

B. **Banbury Springs Limpet *(Lanx sp.)***
Status: Endangered

The Banbury Springs Limpet can commonly be found in association with the Bliss Rapids snail.[ccxlix] The limpet is a small, red-cinnamon colored snail famous for its distinctive conical, pyramid-shaped shell.[ccl] The Banbury Springs limpet is believed to occur in only four coldwater springs along the middle Snake River: Thousand Springs, Box Canyon Springs, Banbury Springs, and Briggs Springs - each of which are isolated from each other, with separating distances of between 1 and 4 miles.[ccli]

Lacking in specialized respiratory organs, the limpet is particularly sensitive to fluctuations in dissolved oxygen levels, and requires cold, clear and well-oxygenated water to survive.[cclii] Discharges of animal waste from industrial agricultural operations into waterways has been strongly linked to sharp reductions in dissolved oxygen levels, the occurrence of which can be fatal to vulnerable limpet populations.[ccliii] Further, the limpet can also be directly affected by decreases in the quality of its aquatic habitat due to nutrient pollution.[ccliv] In analyzing continuing threats to the endangered limpet, the U.S.

Fish and Wildlife Service identified excessive nutrient and sediment loading to the waterways as a species survival concern and determined “agriculture in the form of crop production, cattle grazing, confined animal feeding operations,” to be a major source of these problematic pollutants.[cclv] While current population trends of the limpet are largely uncertain, one thing is surely true: the Banbury Springs limpet is, literally, in deep sh*t.

C. **Snake River Physa Snail *(Physa natricina)***
Status: Endangered

Little is known about the life story of the Snake River Physa snail.[cclvi] What is known is that the Physa is endemic to Idaho, with its range including only a few small sections of the Snake River.[cclvii] This enigmatic little snail is currently listed as endangered, and, much like the limpet and Bliss Rapids snail, requires cold, clean, well-oxygenated water with low turbidity to survive.[cclviii] Despite attempts to implement a recovery plan for this species, the Physa is still in grave danger of disappearing.[cclix] As with the other imperiled snail species of the region, the Physa is believed to be directly affected by nutrient pollution and eutrophication, low dissolved oxygen levels, and sedimentation, all water quality impairments linked to industrial animal production practices.[cclx]

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Endangered and Threatened Wildlife in Twin Falls, Gooding, Jerome Counties, ID: Snake River Physa Snail, Bliss Rapids Snail, Banbury Springs Limpet
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#9 The Lower Yakima Valley, Washington

Counties: Yakima (Human Population: 248,830; Farm Animal Population: 117,843)

Pounds of Poop Produced Annually by Human Population: 45,411,475

Pounds of Poop Produced Annually by Animal Agriculture: 3,313,292,430
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The Lower Yakima Valley

The Lower Yakima Valley of Washington is picturesque, with rolling hills, lush scenery, and abundant wineries. It is also home to a substantial animal agricultural industry. While poultry, swine, and cattle operations can all be found in the Lower Yakima Valley, the area is most known for the size and legacy of its dairy operations. Cumulatively, animal agriculture in Yakima produces over 3 billion pounds of manure each year, landing it in ninth place on this list of Wildlife in Deep Sh*t.

One of the most studied ways animal agriculture is affecting environmental health in the Lower Yakima is through dangerous nitrate contamination to water resources.[cclxi] Most recently, in 2010, EPA sampled drinking water wells in the Lower Yakima Valley to determine the cause of the Valley's ongoing nitrate contamination problems. At the termination of this study, EPA concluded that not only did the evidence point to area's dairies as being the likely source for concerning levels of nitrate pollution, but that the dairies' manure lagoons were "likely leaking large quantities of nitrogen-rich liquid into the subsurface," imperiling all those who rely upon this groundwater.[cclxii]

EPA also determined the Lower Yakima Valley's groundwater resources to be contaminated with high levels of pharmaceutical drugs - specifically, drugs used in industrial animal production, including tetracycline, chlortetracycline, tylosin, and monensin (discussed earlier in relation to the San Joaquin Valley), as well as the hormones testosterone and epistosterone.[cclxiii] EPA's assessment of one of the dairies sampled through the study was, for example, that "is a likely source of tetracycline" into nearby groundwater wells.[cclxiv] Tetracycline is an antibiotic instrumental in human medicine that is used to promote growth in cattle. EPA further found that other pharmaceuticals associated with industrial animal agriculture, such as chlortetracycline and monensin, to also be in a nearby groundwater well, dairy lagoon, manure pile, and application field samples.[cclxv] Similarly, in relation to another dairy that was sampled as part of the study, EPA found that, "[v]eterinary pharmaceuticals [including chlortetracycline, monensin, tylosin, and virginiamycin] were detected in 10 water wells."[cclxvi]
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Table 4-4. Commonly used antimicrobials administered to dairy cows.

Class/Group	Antimicrobial	Life stage	Intended Use
Aminoglycoside	Neomycin*, Streptomycin*	Preweaned	• Treat bacterial enteritis and other digestive problems • Promote animal growth
		Unspecified	• Treat mastitis • Prevent Staphylococcus aureus
β-lactam	Amoxicillin*, Cephalosporin, Penicillin*	Preweaned	• Treat bacterial enteritis and other digestive problems
		Non-lactating	• Treat mastitis and lameness
		Unspecified	• Treat respiratory disease and foot rot
Fluoroquinolone	Enrofloxacin	Non-lactating	• Treat respiratory disease
Ionophore	Lasalocid, Monensin	Weaned	• Treat for respiratory disease and bacterial enteritis • Improved feed efficiency and growth promotion • Increased milk production efficiency
Lincosamide	Pirlimycin Hydrochloride	Non-lactating	• Treat mastitis
Macrolide	Tilmicosin, Tylosin	Non-lactating	• Treat respiratory disease, foot rot, and metritis.
Sulfonamides	Sulfadimethoxine*, Sulfamethazine	Dairy calves and heifers	• Treat bacterial enteritis and other digestive problems • Treat calf diphtheria, shipping fever complex, and foot rot
		Non-lactating	• Treat acute mastitis and metritis
Tetracycline	Chlortetracycline, Oxytetracycline*	Preweaned	• Treat bacterial enteritis and other digestive problems • Promote animal growth
		Non-lactating	• Treat mastitis and lameness • Treat bacterial enteritis and pneumonia

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: USDA 2008a and USFDA 2011b.

Reports similarly link animal production and waste in the Valley to eutrophication and other impairments to the lower Yakima River, as well as to increased air pollution in the region - all of which threaten biodiversity and public health.[cclxvii]

Profiles of Imperiled Species

A. Steelhead Trout *(Oncorhynchus mykiss)*
Status: Threatened

Running through the lower Yakima Valley, the Yakima River is the largest tributary of the Columbia River that is entirely in the state of Washington. The Yakima basin supports at least 48 species of anadromous, resident native, and introduced of fish, and more than 250 species of wildlife. The steelhead trout a type of fish that relies on this water system for survival. Anadromous fish like the steelhead undertake a fascinating migration that takes them from their natal streams all the way out to the ocean, where they carry out their adult lives, and then all the way back to their hatching sites in freshwater for spawning. [cclxviii]

When going back to freshwater streams for spawning, the steelhead requires cool, clear waters for breeding.[cclxix] In these streams, steelhead and their spawn are sensitive to water quality degradation, including from pathogens, pesticides, ammonia, excess nutrients, and fecal coliforms - all water pollutants associated with industrial animal operations.[cclxx] Despite the importance of clean water to steelhead populations, the lower Yakima Valley continues to be faced with ongoing, documented water quality impairment as a result of animal agriculture.[cclxxi] As an example, depleted dissolved oxygen levels in waters - caused by nutrient impairment, specifically associated with industrial animal operations - can negatively impact steelhead populations by lowering embryo survival rates and reducing population numbers.[cclxxii] Further, climate change, including warming water temperatures and increasing ocean acidification, will continue to negatively affect steelhead populations.[cclxxiii]

B. Bull Trout (*Salvelinus confluentus*)
Status: Threatened

Bull trout are members of the char subgroup of the family Salmonidae and range in western North America, including throughout the Yakima and Columbia River Basins.[cclxxiv] The Yakima Basin is considered by FWS to be a "Core Area" for bull trout recovery, with 15 currently identified bull trout populations.[cclxxv]

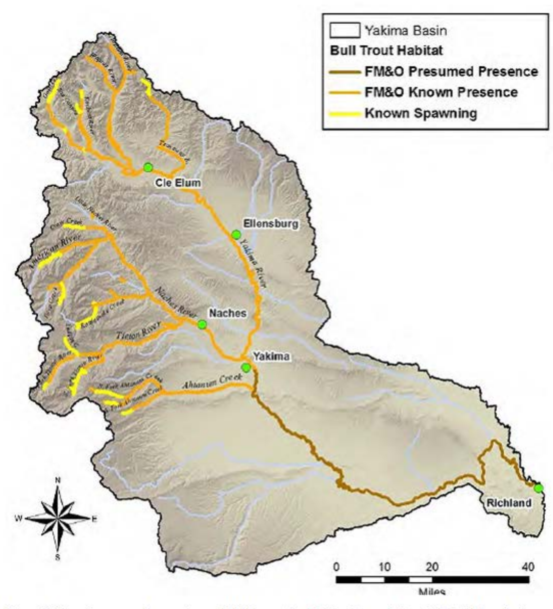

Figure 1. Overview map of spawning and FMO areas for bull trout populations in the Yakima Basin. (Data provided by WDFW.)

Of all salmonid species, bull trout are the most sensitive to water quality and temperature, needing consistently cold and clear water to survive and spawn. Due to this sensitivity, like with the steelhead, animal agriculture in the Yakima Valley can negatively affect bull trout populations in a number of way, including water extraction and use, water quality degradation, and rising water temperatures due to climate change.[cclxxvi] Agricultural pollution has been linked to severe water quality impairment across the basis, including as a result of agricultural chemicals that "have legacy and current impacts that reduce quality of [foraging, migration, and overwintering] and degrade connectivity for bull trout populations."[cclxxvii] The use of river water for irrigation of agricultural crops further significant impacts bull trout populations by reducing in-stream flow, capturing migrating trout through unscreened diversions, and potentially causing increased water temperatures.[cclxxviii] Additionally, sedimentation - as a result of runoff and erosion from agricultural fields - is particularly problematic for bull trout, impeding early development and leading to diminished spawning success.[cclxxix]

C. **Yellow-Billed Cuckoo *(Coccyzus americanus)***
Status: Threatened

The yellow-billed cuckoo - sometimes called the "rain crow" because its song is often heard just before thunderstorms or summer showers - is rapidly approaching extinction in the western states. These calls and others - like cuckoo's distinctive "knocking call" - make the yellow-billed cuckoos fairly easy to hear, even while they remain difficult to spot.[cclxxx] A relative to the greater roadrunner, nesting pairs of yellow-billed cuckoos will react to threats with a "distraction display" to lure potential predators away from the nest site. In this display, one of the pair will remain on the nest while the other hops to a visible perch and flaps its wings and tail to "distract" the perceived threat. These mannerisms are both characteristic and unique to the cuckoo.

However, dramatic riparian habitat loss from development, livestock grazing, and agriculture have severely crippled the environment on which these birds once thrived.[cclxxxiii] Habitat loss is especially critical for this bird because they require large blocks of riparian forest to breed.[cclxxxiv] In addition to fragmentation, pollution and degradation from industrial animal production can also negatively influence the productivity of riparian habitats and negatively affect the endurance of the cuckoo. Entirely dependent on the ability of their riparian habitats to provide them with everything they need, any threat to the productivity of these habitats, including industrial animal agriculture, is a threat to these beautiful birds.

Endangered and Threatened Wildlife in Yakima and Directly Downstream, WA: Yellow-billed Cuckoo, Oregon Spotted Frog, Northern Spotted Owl, Marbled Murrelet, Gray Wolf, Bull Trout, Steelhead Trout, Columbia Basin Pygmy Rabbit

#10 South Central Arizona

Counties: Maricopa, Pinal (Human Population: 4,574,531; Farm Animal Population: 200,522)

Pounds of Poop Produced Annually by Human Population: 834,851,908

Pounds of Poop Produced Annually by Animal Agriculture: 5,596,184,420

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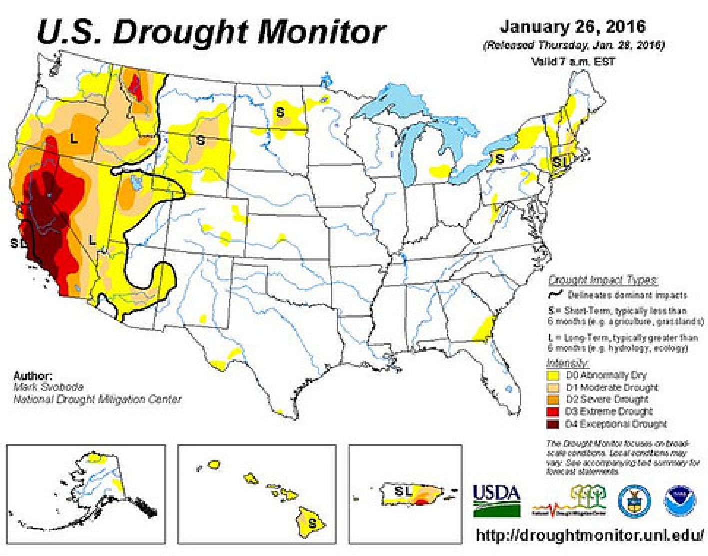
South Central Arizona

The final area on this list of Wildlife in Deep Sh*t is south central Arizona. Home to the Sonoran Desert, the Kaibab National Forest, the Grand Canyon, and currently twenty-two sovereign American Indian communities,[cclxxxv] Arizona is incredibly rich in culture and biodiversity. But what most people don't know is that with two of the country's top twenty milk producing counties, Maricopa and Pinal, Arizona is also a major location for industrial animal agriculture.[cclxxxvi] Each year in these two counties, dairy cows produce a cumulative 5.2 billion pounds of farm animal waste, a majority of the region's total waste production.

In Pinal County, for instance, one dairy operation can alone house 10,000 cows.[cclxxxvii] Operations of this size are subject to a variety of environmental concerns. For example, a 10,000 head operation that holds its cows in open feedlots is susceptible to the unfettered release of noxious air pollution from the animals and their waste, including the greenhouse gases methane and nitrous oxide. An operation of this size would also require an estimated 120 million gallons of water annually to operate.[cclxxxviii] With Arizona receiving an average of only 8-12 inches of rain a year, even if an operation recycles or reclaims portions of the water it uses, that is a significant draw on an already scarce resource.[cclxxxix]



Further, it is not only the local animal agricultural industry in Arizona that is stressing the state's water resources. The largest dairy company in Saudi Arabia - Almarai Co. - is also relying on Arizona's groundwater aquifers to grow alfalfa hay that it can ship back to its cows on the Arabian Peninsula.[ccxc] In order to grow the alfalfa, a particularly water thirsty crop, the Almarai
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operation relies on 15 water wells, which can each pump about 1.5 billion gallons of water.[ccxci] At capacity, that could adds up to an astonishing 22.5 billion gallons of the state's precious water resources being extracted by just one operation for the benefit of international animal agriculture.

On top of water scarcity and air pollution, there is also the continuing threat of water quality impairment due to waste discharges from industrial animal operations. For example, industrial animal feeding operations are recognized as a source of *E. coli* bacteria in the San Pedro River Watershed, the major river system that runs through Pinal County that is currently failing to meet water quality standards for *E. coli* contamination.[ccxcii]

Profiles of Imperiled Species

A. Northern Mexican Gartersnake (Thamnophis eques megalops)
Status: Threatened

As oases in the desert, Southwestern streams are among the most delicate ecosystems on the planet, delicate and vital. Mexican gartersnakes are riparian obligates, meaning they tend to be found in Southwest riparian areas with permanent water, streams in valley floors, and occasionally in desert and lower oak woodland habitats.[ccxciii] Indeed, "[t]he presence of surface water is a primary habitat component for northern Mexican and narrow-headed gartersnakes."[ccxciv] Although considered an aquatic species, the northern Mexican gartersnake also uses terrestrial habitat for hibernation, gestation, seeking mates, and dispersal.[ccxcv] Population trends reveal that the Mexican garter snake is declining in the United States, with currently only a few hundred snakes remaining.

Land uses that divert, dry up, or significantly pollute aquatic habitat are considered significant threats to the northern Mexican gartersnake.[ccxcvi] Groundwater pumping to support agriculture has resulted in extensive historic habitat loss for the Mexican garter snake, including once perennial reaches of the San Pedro, Santa Cruz, Gila, and other rivers that are now dry for much of the year, effects that may be exacerbated by the effects of drought facing the southwestern United States.[ccxcvii] Beyond loss of habitat, industrial animal production may also cause secondary affects to the northern Mexican gartersnake by reducing its food base. For example, discharges of industrial animal waste into waterways may restrict prey population numbers by contributing to water quality degradation, resulting in harmful or fatal water quality conditions.[ccxcviii]

B.* Razorback Sucker *(Xyrauchen texanus)
Status: Endangered

The razorback sucker is a large, warm-water fish native to the Colorado River basin that is distinguishable by the humpback-like protrusion on its back. The sucker does not reach full maturity until age 4, and, when healthy, has been known to live for over 40 years.[ccxcix] Once common throughout the Colorado river basin, the sucker is now reduced to less than a quarter of its former range.[ccc] Incredibly rare in most areas, this remarkable fish was listed as critically endangered in 1991, and remains so to this day, with remaining fragmented wild populations in serious jeopardy.[ccci] Razorback suckers are threatened with extinction due to the "cumulative effects of environmental impacts that have resulted in habitat loss (including alterations to natural flows and changes to temperature and sediment regimes), proliferation of nonnative introduced fish, and other man-induced disturbances" including water quality degradation and the effects of climate change on the sucker's aquatic ecosystems.[cccii] Through runoff into aquatic habitats, pollution from industrial animal operations can expose the fish to surface and groundwater contamination - including the effects of endocrine disrupting chemicals, as well as ambient air pollution, ammonia deposition, and other impairments to the razorback's critical habitat.

C. **Southwest Willow Flycatcher** ***(Empidonax trailii extimus)***
Status: Endangered

The southwestern willow flycatcher is a small, insect-eating migratory bird that is known to be found in Arizona, among other western states.[ccciii] Like the northern Mexican gartersnake, the flycatcher is reliant on a dwindling riparian habitat for survival, with as much as 90 percent of this little bird's habitat already considered to have already been lost or modified.[ccciv] Specifically, large scale losses of southwestern wetlands and "changes in riparian plant communities have resulted in the reduction, degradation, and elimination of nesting habitat for the willow flycatcher, curtailing the ranges, distributions, and numbers of western subspecies."[cccv] Habitat loss and modification for the southwest willow flycatcher is attributable to agricultural development, water diversion and impoundment, channelization, and livestock grazing.[cccvi] To bring back population numbers, there must be improvements in the flycatcher's habitat, including actions to "improve and expand the quality, quantity, and distribution of riparian habitat," improving and reestablishing stream flows, protecting floodplain habitat, and "manag[ing] livestock grazing to increase flycatcher habitat quality and quantity."[cccvii] To meet these goals, it is necessary to meaningfully amend and reconsider the animal agricultural uses in the flycatcher's habitat, including land and water resources.

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Endangered and Threatened Wildlife in Maricopa and Pinal Counties, AZ: Spikedace, Southwestern Willow Flycatcher, Sonoran Pronghorn, Razorback Sucker, Ocelot, Yellow-billed Cuckoo, Mexican Spotted Owl, Yuma Clapper Rail, Lesser Long-nosed Bat, Gila Topminnow, Desert Pupfish, Colorado Pikeminnow, California Least Tern, Northern Mexican Gartersnake, Loach Minnow, Gila Chub, Chiricahua Leopard Frog, Bald Eagle[cccviii], Woundtail, Roundtail Chub

CONCLUSION

America's farmed animals produce over 1.4 trillion pounds of animal waste a year, much of which is generated in large industrial animal feeding operations.[cccix] Better regulation and disposal of this waste is an important short-term mitigation strategy for improving environmental health and lessening the impacts from animal agricultural operations to endangered and
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threatened species. However, without further systemic change, the number of animals produced for meat and dairy in this country combined with the sheer scale of these operations creates a cycle that will continue to threaten the environmental and public health. Breaking our reliance on industrially animal agriculture, including by reducing the amount of meat and dairy in our diets, is crucial to creating a more sustainable and healthier future.

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[i] This report focuses exclusively on threatened and endangered wildlife, while the map also includes threatened and endangered plant species.

[ii] *Waterkeeper Alliance, Inc. v. U.S. Envtl. Prot. Agency*, 399 F.3d 486, 492 (2d Cir. 2005) (citation omitted).

[iii] *See* 68 Fed. Reg. 7188; 40 C.F.R. §§ 122.23(b)(1)(i-ii) & (b)(2).

[iv] National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, Proposed CAFO Regulations, 66 Fed. Reg. 2960, 2972 (Jan. 12, 2001); National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs), 68 Fed. Reg. 7176, 7181 (Feb. 12, 2003).

[v] *See* EPA, National Pollutant Discharge Elimination System (NPDES) Concentrated Animal Feeding Operation (CAFO) Reporting Rule; Proposed Rule, 76 Fed. Reg. 65431, 65434 (Oct. 21,2011); EPA, National Water Quality Inventory: Report to Congress - 2004 Reporting Cycle, EPA-841-R-08-001 (Jan. 2009), available at https://www.epa.gov/waterdata/national-water-quality-inventory-report-congress ; *see also* National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, Proposed CAFO Regulations, 66 Fed. Reg. 2960, 2981 (Jan. 12, 2001) ("In 1997, the Hoosier Environmental Council documented the reduction in biodiversity due to AFOs in a study of three Indiana stream systems. That study found that waters downstream of animal feedlots (mainly hog and dairy operations) contained fewer fish and a limited number of species of fish in comparison with reference sites. It also found excessive algal growth, altered oxygen content, and increased levels of ammonia, turbidity, pH, and total dissolved solids.").

[vi] Machovina, et al., Biodiversity Conservation: The Key is Reducing Meat Consumption, 536 Science of the Total Environment 419, 422 (2015), available at http://www.cof.orst.edu/leopold/papers/Machovina_2015.pdf ; Diaz & Rosenberg, Spreading Dead Zones and Consequences for Marine Ecosystems, 321 Science 926 (2008); EPA, Nutrient Pollution, Effects on the Environment, https://www.epa.gov/nutrientpollution/effects-environment (last visited Dec. 13, 2016); Chesapeake Bay Foundation, Dead Zones, http://www.cbf.org/about-the-bay/issues/dead-zones (last visited Dec. 15, 2016).

[vii] As the Government Accountability Office accurately summarizes, "a dairy farm meeting EPA's large CAFO threshold of 700 dairy cows can create about 17,800 tons of manure annually, which is more than the about 16,000 tons of sanitary waste per year generated by the almost 24,000 residents of Lake Tahoe, California. Likewise, a median-sized beef cattle operation with 3,423 head of beef cattle can produce more than 40,000 tons of manure annually, which is more than the almost 38,900 tons of sanitary waste per year generated by the nearly 57,000 residents of Galveston, Texas. Similarly, some larger farms can produce more waste than some large U.S. cities. For example, a large farm with 800,000 hogs could produce over 1.6 million tons of manure per year, which is one and a half times more than the annual sanitary waste produced by the city of Philadelphia, Pennsylvania—about 1 million tons—with a population of almost 1.5 million. Moreover, a beef cattle farm with 140,000 head of cattle could produce over 1.6 million tons of manure annually, more than the almost 1.4 million tons of sanitary waste generated by the more than 2 million residents of Houston, Texas." GAO, *Concentrated Animal Feeding Operations: EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of*

Concern, GAO-08-944, 19-20 (2008) (citations omitted), *available at* http://www.gao.gov/new.items/d08944.pdf [hereinafter GAO CAFO Report].

[viii] EPA, Detecting and Mitigating the Environmental Impacts of Fecal Pathogens Originating from Confined Animal Feeding operations: Review, EPA/600/R-06/021, 1-3 (Sept. 2005) (citations omitted) (" Animal wastes contain zoonotic pathogens, which are viruses, bacteria, and parasites of animal origin that cause disease in humans. Diseases that can be caused by zoonotic pathogens include Salmonellosis, Tuberculosis, Leptospirosis, infantile diarrheal disease, Q-Fever, Trichinosis, Cryptosporidiosis, and Giardiasis to name a few. These diseases typically present as mild diarrhea, fever, headaches, vomiting, and muscle cramps. In more severe cases, however, these diseases may cause meningitis, hepatitis, reactive arthritis, mental retardation, miscarriages, and even death, particularly in the immunocompromised. *The dosing of livestock animals with copious amounts of antimicrobial agents for growth promotion and prophylaxis may promote antimicrobial resistance in pathogens, increasing the severity of disease and limiting treatment options for sickened individuals*.") (emphasis added); National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs), 68 Fed. Reg. 7176, 7235-36 (Feb. 12, 2003).

[ix] National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs), 68 Fed. Reg. 7176, 7181 (Feb. 12, 2003); *id*. at 7181 ("Among the reported environmental problems associated with animal manure are surface water (e.g., lakes, streams, rivers, and reservoirs) and ground water quality degradation, adverse effects on estuarine water quality and resources in coastal areas and effects on soil and air quality. The scientific literature, which spans more than 30 years, documents how this degradation can contribute to increased risk to aquatic and wildlife ecosystems; an example is the large number of fish kills in recent years. Human and livestock animal health can also be affected by excessive nitrate levels in drinking water and exposure to waterborne human pathogens and other pollutants in manure. The administrative record provides more detailed information on the scientific and technical research to support these findings."); Burkholder, et al., Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality, 115 Environmental Health Perspectives 308 (Feb. 2007), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817674/pdf/ehp0115-000308.pdf .

[x] The measure of dissolved oxygen in a waterbody is a strong indicator of the health of that waterway. As water quality becomes impaired, by - for example - nutrient pollution, oxygen levels in waterbodies can drop below normal levels, leading to inhospitable living environment for the organisms and other creatures that rely upon health in those waters. These dips can lead to die offs in those waters, for example in the form of fish kills. *See, e.g.*, USDA, NRCA, Agricultural Waste Management Field Handbook, Agricultural Wastes, Air, and Animal Resources, at 3-3 (2012), *available at* http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=31441.wba ("Adding wastes to a stream can lower oxygen levels to such an extent that fish and other aquatic life are forced to migrate from the polluted area or die for lack of oxygen.").

[xi] EPA, National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, Proposed CAFO Regulations, 66 Fed. Reg. 2960, 2981 (Jan. 12, 2001) ("Eutrophication is the process in which phosphorus and nitrogen over-enrich water bodies and disrupt the balance of life in that water body. As a result, the excess nutrients cause fast-growing algae blooms. The 1998 National Water Quality Inventory indicates that excess algal growth is the seventh leading stressor in lakes, ponds, and reservoirs. Rapid growth of algae can lower the dissolved oxygen content of a water body to levels insufficient to support fish and invertebrates. Eutrophication can also affect phytoplankton and zooplankton population diversity, abundance, and biomass, and increase the mortality rates of aquatic species. Floating algal mats can reduce the penetration of sunlight in the water column and thereby limit growth of seagrass beds and other submerged vegetation. This in turn reduces fish and shellfish habitat. This reduction in submerged aquatic vegetation adversely affects both fish and shellfish populations."); *id*. at 2981 ("Increased algal growth can also raise the pH of waterbodies, as algae consume dissolved carbon dioxide to support photosynthesis. This elevated pH can harm the gill epithelium of aquatic organisms. The pH may then drop rapidly at night, when algal photosynthesis stops. In extreme cases, such pH fluctuations can severely stress aquatic organisms."); id. at 2981-82 ("Eutrophication is also a factor in the growth of toxic microorganisms, such as cyanobacteria (a toxic algae) and Pfiesteria piscicida, which can affect human health as well. Decay of algal blooms and night-time respiration can

further depress dissolved oxygen levels, potentially leading to fish kills and reduced biodiversity. In addition, toxic algae such as cyanobacteria release toxins as they die, which can severely impact wildlife as well as humans. Researchers have documented stimulation of Pfiesteria growth by swine effluent discharges, and have shown that the organism's growth can be highly stimulated by both inorganic [2982] and organic nitrogen and phosphorus enrichments.")

[xii] EPA, Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions, Memorandum from Nancy Stoner, Acting Assistant Administrator, to Regional Administrators for Regions 1-10, 1 (Mar. 16, 2011), available at https://www.epa.gov/sites/production/files/documents/memo_nitrogen_framework.pdf ; see also DeSimone, et al., The Quality of Our Nation's Waters: Quality of Water from Domestic Wells in Principle Aquifers of the United States, 1991-2004; Overview of Major Findings, USGS Circular 1332 (2009), available at https://pubs.usgs.gov/circ/circ1332/includes/circ1332.pdf

[xiii] *Id*.

[xiv] National Pollutant Discharge Elimination System Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations, 68 Fed. Reg. 7179 (Feb. 12, 2003) (codified at 40 C.F.R. pts. 9, 122, 123, 412).

[xv] U.S. Food and Drug Administration, 2014 Summary Report on Antimicrobials Sold or Distributed for Use in Food producing Animals, 16-17 (2015), *available at* http://www.fda.gov/AnimalVeterinary/NewsEvents/CVMUpdates/ucm476256.htm ("In 2014, sales and distribution (domestic and export) of antimicrobials approved for use in food-producing animals was approximately 15.4 million kilograms. Domestic sales and distribution of antimicrobials approved for use in food-producing animals was approximately 15.36 million kilograms (approximately 100%), and export sales and distribution was approximately 31 thousand kilograms (< 1%). Tetracyclines accounted for 43% and ionophores for 31% of domestic sales. Tetracyclines accounted for 22% of export sales."); U.S. Food and Drug Administration, Report: Estimate of Antibacterial Drug Sales for Use in Humans, 2 (Apr. 5, 2012), *available at* http://www.fda.gov/downloads/Drugs/DrugSafety/InformationbyDrugClass/UCM319435.pdf ("Approximately 3.28 million kilograms of selected systemic antibacterial drug products were sold during year 2010, and around 3.29 million kilograms were sold during year 2011."); Mellon, et al., Hogging It!: Estimates of Antimicrobial Abuse in Livestock Union of Concerned Scientists, Cambridge, MA (2001).

[xvi] Bradford, et al., Reuse of Concentrated Animal Feeding Operation Wastewater on Agricultural Lands, 37 Journal of Envt'l Quality S-97, S-100 (2008), *available at* https://www.ars.usda.gov/sp2UserFiles/Place/20360500/pdf_pubs/P2194.pdf ("Most of the antibiotics are not metabolized completely and are excreted from the treated animal shortly after medication. It was found that as much as 80% of the administered antibiotics occurred as parent compounds in animal wastes.") (citations omitted).

[xvii] *See, e.g.,* Carvalho, et al., A review of plant-pharmaceutical interactions: from uptake and effects in crop plants to phytoremediation in constructed wetlands, 21 Environ Sci Pollut Res 11729 (2014); Daughton, Cradle-to-cradle stewardship of drugs for minimizing their environmental disposition while promoting human health. I. Rationale for and avenues toward a green pharmacy, 111 Environ Health Perspect 757 (2003), available at http://c.ymcdn.com/sites/www.productstewardship.us/resource/resmgr/imported/green1.pdf ; Drillia, et al., Fate and mobility of pharmaceuticals in solid matrices, 60 Chemosphere 1034 (2005); Fent, et al., Ecotoxicology of human pharmaceuticals, 76 Aquat Toxicol 122 (2006); Thiele-Bruhn, Pharmaceutical antibiotic compounds in soils – a review, 166 J Plant Nutr Soil Sci 145 (2003), available at https://www.researchgate.net/publication/227530661_Pharmaceutical_Antibiotic_Compounds_in_Soils_-_A_Review ; Peak, et al., Abundance of Six Tetracycline Resistance Genes in Wastewater Lagoons at Cattle Feedlots with Different Antibiotic use Strategies, 9 Environmental Microbiology 143 (2007); Pinheiro, et al., Veterinary Antibiotics and Hormones in Water from Application of Pig Slurry to Soil, 129 Agricultural Water Management 1 (2013).

[xviii] *See, e.g.*, Blehert, et al., USGS, Investigation of Bacterial Pathogens Assocated with Concentrated Animal Feeding Operations (CAFOs) and their Potential Impacts on a National Wildlife Refuge in Oklahoma: Final Report, Project 2N44, 200120004, at 2 (July 24, 2004); Marshall & Levy, Food Animals and Antimicrobials: Impacts on Humans, 24 Clinical Microbiology Reviews 718 (2011), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3194830/pdf/zcm718.pdf .

[xix] *See* Lee, et al., Agricultural Contributions of Antimicrobials and Hormones on Soil and Water Quality, 93 Advances in Agronomy 1, 6 (2007) ("Because many antimicrobials are poorly absorbed in the digestive tract of animals, these compounds are often present in livestock wastes in significant concentrations. Tetracyclines, sulfonamides, b-lactams, macrolides, and ionophores are examples of antimicrobial classes that are frequently detected in manure wastes. In a study of a number of poultry and swine production facilities [for example], antimicrobials were found in all swine storage lagoon samples .... Antimicrobials were also found in 31% of surface and groundwater samples collected proximal to the swine farms and in 67% of surface and groundwater samples proximal to poultry farms.") (citations omitted); *see also* Dutta, et al., Dissolved Organic Carbon and Estrogen Transport in Surface Runoff from Agricultural Land Receiving Poultry Litter, Journal of American Water Resources Association (June 2012); Finlay-Moore, et al., 17 beta-estradiol and testosterone in soil and runoff from grasslands amended with broiler litter, 29 Journal of Environmental Quality 1604 (2000); Shore & Shemesh, Naturally produced steroid hormones and their release into the environment, 75 Pure and Applied Chemistry 1859 (2003); Blazer, et al., Intersex (Testicular Oocytes) in Smallmouth Bass from the Potomac River and Selected Nearby Drainages, 19 Journal of Aquatic Health 242 (2007).

[xx] Bradford, et al., Reuse of Concentrated Animal Feeding Operation Wastewater on Agricultural Lands, 37 Journal of Envtl Quality S-97, S-101 (2008), *available at* https://www.ars.usda.gov/sp2UserFiles/Place/20360500/pdf_pubs/P2194.pdf (Studies "reported detection of steroid hormones in approximately 90% of the 139 sampled streams in a survey conducted across the United States .... In addition to municipal wastewater treatment plants, CAFOs have been considered as an important source for the release of hormones into the environment. In contrast to sewage treatment plants that degrade estrogens fairly rapidly, CAFO lagoons typically function as holding reservoirs or anaerobic reactors, and waste effluent generally receives no additional treatment before land application. It has been estimated that estrogen loads from land application by livestock manure account for greater than 90% of the total estrogen in the environment. Results ... indicate that high concentrations of estrogens in CAFO lagoon water could significantly elevate their concentrations in receiving surface waters and ground water. Numerous reports show that steroid hormones released from animal waste have been measured in both surface water and ground water.") (citations omitted); *see also* National Institute of Environmental Health Sciences, Endocrine Disruptors, http://www.niehs.nih.gov/health/topics/agents/endocrine/ (last visited Aug. 8, 2016); Arnon, et al., Transportation of Testosterone and Estrogen from Dairy-Farm Waste Lagoons to Groundwater, 42 Environmental Science & Technology 5521 (2008).

[xxi] National Research Council of the National Academies, Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs; Final Report, 50-56 (2003).

[xxii] *Id; see also* Iowa State University, Iowa Concentrated Animal Feeding Operations Air Quality Study; Final Report, 35-45 (2002), available at https://www.public-health.uiowa.edu/ehsrc/CAFOstudy/CAFO_final2-14.pdf

[xxiii] United National Environment Programme, Growing Greenhouse Gas Emissions Due to Meat Production, 4 (Oct. 2012), available at http://www.unep.org/pdf/unep-geas_oct_2012.pdf ; see also Gerber, P.J., et al., Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations, xii (2013), available at http://www.fao.org/3/i3437e.pdf ; FAO, Livestock's Long Shadow: Environmental Issues and Options, xxi (2006), available at http://www.fao.org/docrep/010/a0701e/a0701e00.HTM ; Machovina, et al., Biodiversity Conservation: The Key is Reducing Meat Consumption, 536 Science of the Total Environment 419, 424 (2015), available at http://www.cof.orst.edu/leopold/papers/Machovina_2015.pdf

[xxiv] EPA, Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2014, EPA 430-R-16-002 at 2-18 (2016), available at https://www.epa.gov/sites/production/files/2016-04/documents/us-ghg-inventory-2016-main-text.pdf

("The majority of the increase observed in CH4 resulted from swine and dairy cow manure, where emissions increased 44 and 118 percent, respectively, from 1990 to 2014.")

[xxv] *Id*. at ES-6; see also *id*. at ES-20; Food & Agriculture Organization of the United Nations, Livestock's Long Shadow: environmental issues and options, at xxi (2006), *available at* ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e.pdf

[xxvi] EPA, Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2014, EPA 430-R-16-002 at ES_14, 2-4, 5-1 (2016), available at https://www.epa.gov/sites/production/files/2016-04/documents/us-ghg-inventory-2016-main-text.pdf ; National Association of Local Boards of Health, Understanding Concentrated Animal Feeding Operations and Their Impacts on Community Health, 7 (2010), *available at* https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf (" The type of manure storage system used contributes to the production of greenhouse gases. Many CAFOs store their excess manure in lagoons or pits, where they break down anaerobically (in the absence of oxygen), which exacerbates methane production. Manure that is applied to land or soil has more exposure to oxygen and therefore does not produce as much methane. Ruminant livestock, such as cows, sheep, or goats, also contribute to methane production through their digestive processes. These livestock have a special stomach called a rumen that allows them to digest tough grains or plants that would otherwise be unusable. It is during this process, called enteric fermentation, that methane is produced. The U.S. cattle industry is one of the primary methane producers. Livestock production and meat and dairy consumption has been increasing in the United States, so it can only be assumed that these greenhouse gas emissions will also rise and continue to contribute to climate change.").

[xxvii] Food & Agriculture Organization of the United Nations, Livestock's Long Shadow: environmental issues and options, at xxi (2006), *available at* ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e.pdf

[xxviii] FAO, Livestock's Long Shadow: Environmental Issues and Options, xxi (2006), available at http://www.fao.org/docrep/010/a0701e/a0701e00.HTM ; *see also* Alexandratos & Bruinsma, Food and Agriculture Organization of the United Nations, World Agriculture Towards 2030/2050, ESA Working Paper No. 12-03, at 132 (2012), available at http://www.fao.org/docrep/016/ap106e/ap106e.pdf ; Machovina, et al., Biodiversity Conservation: The Key is Reducing Meat Consumption, 536 Science of the Total Environment 419, 420 (2015), available at http://www.cof.orst.edu/leopold/papers/Machovina_2015.pdf

[xxix] UCS, CAFOs Uncovered at 29 ("Livestock raised in confinement eat an enormous amount of corn and soybeans. Grain and animal production (and their respective costs) are therefore inseparable when evaluating [industrial animal] production.... A majority of the two most widely cultivated crops in the United States, corn and soybeans, is fed to livestock."); Nickerson, et al., Major Uses of Land in the United States, 2007, USDA-Economic Research Service, Economic Information Bulletin No. 89, at 4, Table 1 (2011), available at https://www.ers.usda.gov/webdocs/publications/eib89/11159_eib89_2_.pdf?v=41055 ; Pimentel and Pimentel, Sustainability of Meat-Based and Plant-Based Diets and the Environment, 78 (Supp.) Am J Clin Nutr 660S, 661S (2003).

[xxx] Machovina, et al., Biodiversity Conservation: The Key is Reducing Meat Consumption, 536 Science of the Total Environment 419, 423 (2015), available at http://www.cof.orst.edu/leopold/papers/Machovina_2015.pdf ; Tilman, et al., Forecasting Agriculturally Driven Global Environmental Change, 292 Science 281 (2001).

[xxxi] USDA Economic Research Service, Irrigation & Water Use: Background, http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/background.aspx (last visited Oct. 11, 2016); USGS, Livestock Water Use, http://water.usgs.gov/watuse/wulv.html (last visited Oct. 11, 2016) (note, since "[f]ew State agencies require livestock operations to report water withdrawals, ... most estimates of livestock withdrawals are derived using animal population data and water-use coefficients, in gallons per head per day for each animal type.").

[xxxii] This estimate includes both the drinking water needs of the dairy cows and the service water needs of the operation. Service water is the water required by industrialized operations to clean the production units, wash animals, cooling needs, and waste disposal. The water estimates have been converted from liters to US liquid gallons. *See* Food & Agriculture Organization of the United Nations, Livestock's Long Shadow: Environmental

Issues and Options, at 129, Table 4.2: Drinking water requirements for livestock (2006) (while these numbers vary somewhat depending on the ambient air temperature the animal is subjected to, at the table's most conservative level it can be estimated that industrial milking cows require 102.8 liters of drinking water per animal per day; compare this with non-lactating cattle, which require 44.1 liters of drinking water per animal per day and lactating swine, which require 17.2 liters of drinking water per animal per day); *id*. at 130, Table 4.3: Service water requirements for different livestock types (estimating that industrial milking cows require 22 liters of service water per animal per day; compare this with adult beef cattle, which require 11 liters of service water per animal per day and lactating swine, which require an astonishing 125 liters of service water per animal per day).

[xxxiii] USDA, 2012 Census of Agriculture (2014), *available at* https://www.agcensus.usda.gov/Publications/2012/ ; EPA, Risk Assessment Evaluation for Concentrated Animal Feeding Operations, EPA/600/R-04/042 , Table 3.3 (2004).

[xxxiv] See FWS, Environmental Conservation Online System, http://ecos.fws.gov/ (last visited Dec. 9, 2016).

[xxxv] All human population numbers in the report are from 2015 U.S. Census Data, *available at* https://www.census.gov/ .

[xxxvi] "Farm animal populations" includes dairy cattle, beef cattle, turkey, broiler chicken, layer chicken, and swine. All farm animal population numbers in the report from the 2012 Census of Agriculture. USDA, 2012 Census of Agriculture (2014), *available at* https://www.agcensus.usda.gov/Publications/2012/.

[xxxvii] *Id*.

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[cvi] Complaint, *Board of Water Works Trustees of the City of Des Moines, Iowa v. Sac County Board of Supervisors as Trustees of Drainage Districts 32, 42, 65, 79, 81, 83, 86, et al.*, Case No. 5:15-cv-04020, at ¶ 3 (N.D. Iowa filed Mar. 16, 2015) ("The Des Moines Water Works is a regional water utility providing drinking water to approximately half a million Iowans, both by direct service and by wholesale service to other utilities and districts, that obtains its raw water supply primarily from the Raccoon and Des Moines Rivers.").

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[cix] In August 2014, the Center for Biological Diversity and partner groups petitioned the U.S. Fish and Wildlife Service to protect the Monarch butterfly as a threatened species under the ESA. Center for Biological Diversity, et al., *Petition to Protect the Monarch Butterfly (Danaus plexippus plexippus) Under the Endangered Species Act* (Aug. 26, 2014), *available at* https://www.biologicaldiversity.org/species/invertebrates/pdfs/Monarch_ESA_Petition.pdf. In December 2014, the U.S. Fish and Wildlife Service determined that protection under the Act may be warranted, triggering an official review of the monarch butterfly's status; by law that review should have been completed within 12 months. FWS, Endangered and Threatened Wildlife and Plants; 90-Day Finding on Two Petitions, 79 Fed. Reg. 78775, 78775 (Dec. 31, 2014) (90-Day finding on monarch petition that the petition presented substantial scientific or commercial information indicating that listing of the monarch may be warranted.) By 2016, with FWS yet to issued a final decision, the Center for Biological Diversity and Center for Food Safety filed a lawsuit over the agency's failure to make the required finding. *Center for Biological Diversity, et al., v. Sally Jewell, et al.*, Case No. 16-00145 (D. Ariz. filed Mar. 10, 2016). In November 2016, the Committee on the Status of Endangered Wildlife in Canada recommended that the monarch butterfly be protected in Canada as an endangered species due to population decline and ongoing threats to the butterfly on its migration route; the minister of the Environment and Canadian Endangered Species Conservation Council has nine months from that designation to decide whether to add the butterfly to Canada's endangered species list. See Committee on the Status of Endangered Wildlife in Canada, COSEWIC Wildlife Species Assessments (detailed versions), November 2016 (Dec. 12, 2016), available at http://www.cosewic.gc.ca/rpts/2016_11/Detailed_species_assessments_e.pdf

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[cxi] (USDA ERS 2014a)

[cxii] *See, e.g.,* Hartzler, Reduction in Common Milkweed (Asclepias syriaca) Occurance in Iowa Cropland from 1999 to 2009, 29 Crop Protection 1542 (2010), *available at* http://www.saynotogmos.org/ud2011/fp-content/docs/Hartzler_2010.pdf ("The percentage of crop fields infested with, and the amount of common milkweed present in infested fields declined in the time between the two surveys. In 1999 common milkweed was found in 51% of the crop fields, whereas in 2009 only 8% of the fields were infested with the weed.... The area occupied by common milkweed patches in infested fields declined by approximately 90% from 1999 to 2009.... It was estimated that Iowa corn and soybean fields produced 78 times more monarchs than non-agricultural habitats. Thus, the decline in common milkweed found in corn and soybean fields could affect monarch reproduction within Iowa and surrounding states with similar land use patterns.") (citations omitted).

[cxiii] Our Soy Checkoff advertisement in American Soybean Association, American Soybean Magazine, Vol. 1, 29 (Summer 2013); Jonathan Foley, It's Time to Rethink America's Corn System, Scientific American (Mar. 5, 2013), available at https://www.scientificamerican.com/article/time-to-rethink-corn/ ; *see also* National Corn Growers Association, Corn & Livestock Booklet, *available at* http://www.ncga.com/upload/files/documents/pdf/ncga_livestock_booklet-web.pdf ; E. Starmer & T. Wise, Living High on the Hog: Factory Farms, Federal Policy, and the Structural Transformation of Swine Production, Tufts University Global Development and Environmental Institute Working Paper No. 07-04 (Dec. 2007), *available at* http://www.ase.tufts.edu/gdae/Pubs/wp/07-04LivingHighOnHog.pdf ; USDA-ERS, Corn, Background, https://www.ers.usda.gov/topics/crops/corn/background/ (last visited Dec. 20, 2016) ("More than 90 million acres of land are planted to corn, with the majority of the crop grown in the Heartland region. Most of the Crop is used as the main energy ingredient in livestock feed.").

[cxiv] Cornell University, "U.S. Could Feed 800 Million People with the Grain That Livestock Eat, Cornell Ecologist Advises Animal Scientists," Cornell Chronicle (Aug. 7, 1997), available at http://www.news.cornell.edu/stories/1997/08/us-could-feed-800-million-people-grain-livestock-eat ; E. Cassidy, et al., Redefining Agricultural Yields: From Tonnes to People Nourished Per Hectare, 8 Environmental Research Letters 034015 (2013), available at http://iopscience.iop.org/article/10.1088/1748-9326/8/3/034015/pdf;jsessionid=AFAB9EDAB2629947208107B1D242E4AC.c1.iopscience.cld.iop.org ; J. Foley, A Five Step Plan to Feed The World, National Geographic Magazine (DATE), available at http://www.nationalgeographic.com/foodfeatures/feeding-9-billion/ ("For every 100 calories of grain we feed animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.").

[cxv] *See* FWS, Endangered and Threatened Wildlife and Plants; Final Rule to List the Topeka Shiner as Endangered, 63 Fed. Reg. 69008 (Dec. 15, 1998).

[cxvi] *Id*. at 69008.

[cxvii] *Id*. at 69016.

[cxviii] Id. at 69008; Complaint, Board of Water Works Trustees of the City of Des Moines, Iowa v. Sac County Board of Supervisors as Trustees of Drainage Districts 32, 42, 65, 79, 81, 83, 86, et al., Case No. 5:15-cv-04020, at ¶ 1 (N.D. Iowa filed Mar. 16, 2015); see also Adelman, et al., Acute and Chronic Toxicity of Ammonia, Nitrite, and Nitrate to the Endangered Topeka Shiner (Notropis topeka) and Fathead Minnows (Pimephales promelas), 28 Environmental Toxicology and Chemistry 2216, 2216 (2009), available at http://onlinelibrary.wiley.com/doi/10.1897/08-619.1/epdf?r3_referer=wol&tracking_action=preview_click&show_checkout=1&purchase_referrer=www.ncbi.nlm.nih.gov&purchase_site_license=LICENSE_DENIED_NO_CUSTOMER ("Land cover in watersheds that currently or previously contained Topeka shiners is predominantly agricultural with intensive fertilizer and pesticide use. Those watersheds contain confined animal feeding operations and rural towns that discharge municipal waste into streams containing Topeka shiner habitat and dispose of sewage sludge on adjacent land. The confined animal

operations, municipal sewage treatment plants, and sewage sludge disposal sites are sources of organic solids, nutrients, and hormonally active ingredients. The cumulative point-source and non-point-source loading of nitrogen from those wastes may limit the recovery of the Topeka shiner if concentrations of ammonia, nitrite, or nitrate are sufficiently high to cause lethal or sublethal effects.").

[cxx] *See* Zurek & Ghosh, Insects Represent a Link Between Food Animal Farms and the Urban Environment for Antibiotic Resistance Traits, 80 Applied and Environmental Microbiology 3562, 3565 (2014) ("The above studies demonstrate the following: (i) the association of multidrug-resistant bacterial strains of food animal origin with flies and cockroaches, (ii) bacterial proliferation and horizontal transfer of antibiotic resistance genes in the insect digestive tract, and (iii) the potential of these insects to transmit multidrug-resistant bacteria from food animals to the urban environment."); Graham, et al., Antibiotic resistant enterococci and staphylococci isolated from flies collected near confined poultry feeding operations, 407 Sci. Total Environ 2701 (2009); Heuer and Smalla, Manure and Sulfadiazine Synergistically Increased Bacterial Antibiotic Resistance in Soil Over at Least Two Months, 9 Environmental Microbiology 657 (2007) (relation between use of antibiotics and the occurrence of resistance in bacterial isolates from manure has been found).

[cxxi] National Association of Local Boards of Health, Understanding Concentrated Animal Feeding Operations and Their Impacts on Communities, 8 (2010), available at https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf

[cxxii] U.S. FWS, Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-eared Bat with 4(d) Rule; Final Rule, and interim rule with request for comments, 80 Fed. Reg. 17974, 18003 (Apr. 2, 2015) ("Contaminants of concern to insectivorous bats like northern longeared bats include organochlorine pesticides, organophosphate, carbamate and neonicotinoid insecticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), pyrethroid insecticides, and inorganic contaminants such as mercury."); U.S. FWS, Endangered and Threatened Wildlife and Plants; 4(d) Rule for the Northern Long-Eared Bat, 81 Fed. Reg. 1900, 1906 (Jan. 14, 2016) (same).

[cxxiii] USGS, The Chesapeake Bay: Geological Product of Rising Sea Level, Fact Sheet 102-98, http://pubs.usgs.gov/fs/fs102-98/ (last visited Sept. 1, 2016).

[cxxiv] Ator and Denver, Understanding Nutrients in the Chesapeake Bay Watershed and Implications for Management and Restoration - the Eastern Shore, U.S. Geological Survey Circular 14029826, 1 (2015), available at http://pubs.usgs.gov/circ/1406/pdf/circ1406.pdf ; 2001 Proposed CAFO Rule, at ("Reduction in submerged aquatic vegetation due to algal blooms is the leading cause of biological decline in Chesapeake Bay, adversely affecting both fish and shellfish populations. In marine ecosystems, blooms known as red or brown tides have caused significant mortality in marine mammals. In freshwater, cyanobacterial toxins have caused many incidents of poisoning of wild and domestic animals that have consumed impacted waters. Even with no visible signs of the algae blooms, shellfish such as oysters, clams and mussels can carry the toxins produced by some types of algae in their tissue. Shellfish are filter feeders which pass large volumes of water over their gills. As a result, they can concentrate a broad range of microorganisms in their tissues. Concentration of toxins in shellfish provides a pathway for pathogen transmission to higher trophic organisms.”).

[cxxv] Susquehanna River Basin Commission, The Susquehanna, http://www.srbc.net/about/geninfo.htm (last visited Sept. 1, 2016).

[cxxvi] EPA, Chesapeake Bay Compliance and Enforcement Strategy, 9 (2010), available at https://www.epa.gov/sites/production/files/2015-04/documents/chesapeake-strategy-enforcement-2.pdf.

[cxxvii] Id.

[cxxix] *See* American Farm Bureau, et al. v. EPA, XXXX (3d Cir. 2015), cert. denied; Chesapeake Bay Foundation, Chesapeake Clean Water Blueprint, Chesapeake Bay Watershed Pollution Limits, http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/watershed-wide-pollution-limits (last visited Dec. 12, 2016) (According to the EPA, to restore the Bay and its tidal rivers to health there must be Bay-wide nitrogen reductions of 237.61 million lbs/year by 2017 and 207.57 lbs/year by 2025, as well as Bay-wide phosphorus reductions of 6.37 million lbs/year by 2017 and 14.46 million lbs/year by 2025); Darryl Fears, Farm Bureau Takes Aim at EPA Limited on Pollutant Runoff into Chesapeake Bay, Washington Post (Feb. 27, 2011), *available at* http://www.washingtonpost.com/wp-dyn/content/article/2011/02/27/AR2011022703027.html ; Chesapeake Bay Foundation, The Fight to Save the Blueprint, http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/who-is-opposing-the-clean-water-blueprint (last visited Sept. 1, 2016) ; William Baker, The Farm Bureau Can Chose to be a Sore Loser or Part of the Solution, Bay Journal (May 12, 2016), *available at* http://www.bayjournal.com/article/farm_bureau_can_choose_to_be_a_sore_loser_or_part_of_the_solution

[cxxx] Florida Fish and Wildlife Conservation Commission, A Comparison of Three Sturgeon Species, http://myfwc.com/research/saltwater/sturgeon/information/species-comparison/ (last visited Oct. 21, 2016).

[cxxxi] Campbell, et al., Acute Sensitivity of Juvenile Shortnose Sturgeon to Low Dissolved Oxygen Concentrations, 133 Transactions of the American Fisheries 772 (2004); Chesapeake Bay Program, Shortnose Sturgeon, http://www.chesapeakebay.net/fieldguide/critter/shortnose_sturgeon (last visited Sept. 1, 2016).; Secor & Niklitschek, Hypoxia and Sturgeons: Report to the Chesapeake Bay Program Dissolved Oxygen Criteria Team (Mar. 29, 2001), available at http://aquaticcommons.org/3023/1/314-01.pdf .

[cxxxii] Shortnose Sturgeon Status Review Team, NMFS, Biological Assessment of Shortnose Sturgeon, Acipenser brevirostrum, 211 -12 (Nov. 2010), *available at* http://www.nmfs.noaa.gov/pr/pdfs/species/shortnosesturgeon_biological_assessment2010.pdf (In discussing stressors in the Susquehanna Riverine system, "[r]esearch indicates that the Susquehanna River Basin contributes the major portion of nutrients and a significant portion of toxins to the northern Chesapeake Bay. According to a 1998 water quality assessment of the Susquehanna River Basin, nutrient enrichment and habitat alteration were the major causes of stream impairment. Habitat alteration occurred in the form of agricultural runoff …. Agricultural runoff is known to transport high amounts of nitrogen and phosphorous into lake and river systems. The USGS estimates the Susquehanna contributes over 60% of the nitrogen and about 40% of the phosphorous load to the upper Chesapeake Bay.") (citation omitted).; *id*. at 319 (Assessing the Susquehanna a stressor score of 7.25, based in part of water quality as a moderate stressor because of nutrient enrichment and habitat alteration.).
[cxxxiii] *Id*. at 59606.

[cxxxiv] *Id*. at 59608 ("Based on documented losses of bog turtles and their habitat, the northern population has declined by at least 50 percent, with most of the decline occurring over the last 20 years. Habitat destruction and illegal collecting for the pet trade are the primary threats to the species. Widespread alteration of bog turtle habitat has resulted from the draining, ditching, dredging, filling, and flooding of wetlands for … agricultural activities; and pond and reservoir construction."); *id*. at 59615 ("Habitat loss is a major factor for the past and present decline of bog turtles throughout much of their range. Wetland habitats have been drained and filled for development, agriculture, road construction, and impoundments. These activities have also severely fragmented the remaining habitat and have created physical barriers to movement, thus isolating existing bog turtle populations from other such sites. Even when located in upland areas, development and agriculture can also cause indirect hydrological alterations of adjacent wetland habitats. If these alterations present a barrier to surface water or groundwater flow, the wetland can become wetter or drier, either of which may render the habitat less suitable or unsuitable for bog turtles. If surface water flow is intercepted, groundwater recharge may be reduced, potentially reducing water levels in adjacent wetlands."); *id*. ("the use of herbicides and pesticides on adjacent agricultural fields also degrade bog turtle habitat. ")

[cxxxv] FWS, Bog Turtle (Clemmys muhlenbergii) Northern Population Recovery Plan, 11 (May 2001), *available at* http://ecos.fws.gov/docs/recovery_plan/010515.pdf .

[cxxxvi] FWS, Bog Turtle (Clemmys muhlenbergii) Northern Population Recovery Plan, 38 (May 2001), *available at* http://ecos.fws.gov/docs/recovery_plan/010515.pdf ; Endangered and Threatened Wildlife and Plants; Final Rule to

List the Northern Population of the Bog Turtle as Threatened and the Southern Population as Threatened Due to Similarity of Appearance, 62 Fed. Reg. 59605, 59617 (Nov. 4, 1997) (Due to prevalent habitat fragmentation, many remaining extant sites in Pennsylvania are small, isolated, and support few bog turtles; these sites are at great risk from collection, agricultural pollution, and vegetative succession.").

[cxxxvii] Maryland Department of Natural Resources, Rare, Threatened and Endangered Animal Fact Sheet: Maryland Darter, http://dnr2.maryland.gov/wildlife/Pages/plants_wildlife/rte/rteanimalfacts.aspx?AID=Maryland%20Darter (last visited Oct. 21, 2016).

[cxxxviii] Maryland Department of Natural Resources, Rare, Threatened and Endangered Animal Fact Sheet: Maryland Darter, http://dnr2.maryland.gov/wildlife/Pages/plants_wildlife/rte/rteanimalfacts.aspx?AID=Maryland%20Darter (last visited Oct. 21, 2016).

[cxxxix] FWS, Maryland darter, Estheostoma Sellare, https://www.fws.gov/northeast/pdf/MarylandDarter0511.pdf (last visited Sept. 6, 2016) (Darter populations have been studied in tributaries of the Susquehanna - where the fish is primarily believed to be located - including the Swan Creek, Gashey's Run, and Deer Creek, as well as the main stem of the Susquehanna below the Conowingo Dam - an area specifically affected by industrial animal operation activities); see also FWS, Endangered and Threatened Widllife and Plants; 90-Day Finding for a Petition to De-List the Maryland Darter (Etheostoma sellare), 61 Fed. Reg. 5971, 5971-72 (Feb. 15, 1996) (denying a petition filed by the Maryland Farm Bureau to de-list the darter because, while it may no longer be present in the above-listed tributaries, it may be present in the mainstem of the Susquehanna or other tributaries of the Susquehanna); Killian, et al., Surveys for the Endangered Maryland Darter (August 2008 - September 2010), at 1 (XXX), available at http://dnr.maryland.gov/streams/Documents/MarylandDarterSurvey_FINAL_REPORT_2011.pdf.

[cxl] FWS, Maryland darter, Estheostoma Sellare, https://www.fws.gov/northeast/pdf/MarylandDarter0511.pdf (last visited Sept. 6, 2016); *see also* Stranko, Fish Conservation in the Lower Susquehanna River Watershed in Maryland, State of the Susquehanna 2010, 1 (2010) ("Although stream quality is affected by many sources of pollution and habitat destruction, agriculture and urban run-off are the most prevalent problems for streams in the Maryland portion of this watershed. This is especially true for small streams where a small amount of polluted run-off can make a large contribution to the total water in the stream.").

[cxli] The Bald Eagle has been delisted due to recovery, but its populations remain under threat.
[cxlii] Drummond Ayers, Delmarva: The Island on a Peninsula, *The New York Times* (Sept. 12, 1992), *available at* http://www.nytimes.com/1982/09/12/travel/delmarva-the-island-on-a-peninsula.html?pagewanted=all ; see also University of Delaware, The Impact of Nitrogen and Phosphorus from Agriculture on Delaware's Water Quality, 3 (2013), *available at* http://extension.udel.edu/factsheets/the-impacts-of-nitrogen-and-phosphorus-from-agriculture-on-delawares-water-quality/ ("Delaware has four major basins (drainage areas), which define where waters flow: the Piedmont Drainage is in northern Delaware; the Delaware Bay Drainage consists of most of the central eastern part of the state; the Chesapeake Bay Drainage includes the western portion of the state; and the Inland Bays/Atlantic Ocean Drainage is located in southeastern Delaware.")

[cxliii] University of Delaware, Technical Summary: State of the Delaware River Basin Report, 155 (2008), *available at* http://nj.usgs.gov/programs/natmonitornet/pdfs/StateoftheDelRiverBasin08.pdf

[cxliv] USGS, Water Quality in the Delmarva Peninsula: Delaware, Maryland, and Virginia, 1999-2001, 3 (2004), *available at* http://pubs.usgs.gov/circ/2004/1228/pdf/circular1228.pdf

[cxlv] *Id*. (citation omitted); Chris Cadwallader, USDA National Agricultural Statistics Service Delaware Field Office, Profiles of Delaware Agriculture, 4 (YEAR) available at https://www.nass.usda.gov/Statistics_by_State/Delaware/Publications/DE%20Ag%20Brochure_web.pdf (The broiler industry in Delaware uses about 30.6 million bushels of corn and 11.5 million bushels of soybeans annually for broiler feed).

[cxlvi] Chris Cadwallader, USDA National Agricultural Statistics Service Delaware Field Office, Profiles of Delaware Agriculture, 4 (YEAR) available at https://www.nass.usda.gov/Statistics_by_State/Delaware/Publications/DE%20Ag%20Brochure_web.pdf

[cxlvii] Dept. of Natural Resources and Envt'l Control, State of Delaware 2012 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs, 3-4 (2013), *available at* http://www.dnrec.delaware.gov/swc/wa/Documents/WAS/Final%202012%20Integrated%20305(b)%20Report%20and%20303(d)%20list.pdf ; *see also* EPA, Waters Assessed as Impaired Due to Nutrient Related Causes, https://www.epa.gov/nutrient-policy-data/waters-assessed-impaired-due-nutrient-related-causes (last visited Dec. 14, 2016); University of Delaware, The Impact of Nitrogen and Phosphorus from Agriculture on Delaware's Water Quality, 3 (2013), *available at* http://extension.udel.edu/factsheets/the-impacts-of-nitrogen-and-phosphorus-from-agriculture-on-delawares-water-quality/

[cxlviii] *Id* at 4.

[cxlix] University of Delaware, The Impact of Nitrogen and Phosphorus from Agriculture on Delaware's Water Quality, 3 (2013), *available at* http://extension.udel.edu/factsheets/the-impacts-of-nitrogen-and-phosphorus-from-agriculture-on-delawares-water-quality/

[cl] *Id*.

[cli] See generally EPA, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus, and Sediment (Dec. 2010), available at https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-tmdl-document

[clii] Chesapeake Bay Foundation, Chesapeake Clean Water Blueprint, Pollution Limits by State, http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/pollution-limits-by-state (last visited Dec. 15, 2016).

[cliii] *Id*; *see also, supra,* note [cliii].

[cliv] Jacobs and Bleil, Delaware Department of Natural Resources and Environmental Control, Conditions of Nontidal Wetlands in the Nanticoke River Watershed, Maryland and Delaware, 59 (2008), *available at* http://www.dnrec.delaware.gov/admin/delawarewetlands/documents/nanticoke%20wetland%20profile_final.pdf

[clv] Tiner, Assessing Cumulative Loss of Wetland Functions in the Nanticoke River Watershed Using Enhanced National Wetlands Inventory Data, 5 Wetlands 405, 417-18 (2005), *available at* https://www.fws.gov/wetlands/Documents%5CAssessing-Cumulative-Loss-of-Wetland-Functions-in-the-Nanticoke-River-Watershed-Using-Enhanced-NWI-Data.pdf ("Since colonial times, it was estimated that the Nanticoke watershed lost over 60% of its predicted capacity for streamflow maintenance and over one-third of its capacity for four other functions: surface-water detention, nutrient transformation, sediment and other particulate retention, and provision of other wildlife habitat. No function experienced an increase in capacity.").

[clvi] U.S. FWS, Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot, 79 Fed. Reg. 73706, 73707 (Dec. 11, 2014).

[clvii] U.S. FWS, Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot, 79 Fed. Reg. 73706, 73707 (Dec. 11, 2014); Chris Mooney, Climate change is threatening the existence of the world's most amazing bird, Washington Post (Dec. 15, 2014), *available at* https://www.washingtonpost.com/news/wonk/wp/2014/12/15/climate-change-is-threatening-the-existence-of-the-worlds-most-amazing-bird/; Deborah Cramer, Red Knots are Battling Climate Change - On Both Ends of the Earth, Audubon Magazine (May-June 2016), *available at* http://www.audubon.org/magazine/may-june-2016/red-knots-are-battling-climate-change-both-ends .

[clviii] USDA, Questions and Answers: Biology of Avian Influenza and Recent Outbreaks, 1 (May 2015), *available at* http://www.usda.gov/documents/avian-influenza-biology-outbreaks-qa.pdf.

[clix] *Id*.

[clx] *Id*. at 2.

[clxi] World Health Organization, Review of latest available evidence of potential transmission of avian influenza (H5N1) through water and sewage and ways to reduce the risks to human health (Updated), 6 (2007), available at http://www.who.int/water_sanitation_health/emerging/h5n1background.pdf

[clxii] APHIS, USDA, HPAI 2014/15 Confirmed Detections, https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian-influenza-disease/sa_detections_by_states/hpai-2014-2015-confirmed-detections (last visited Aug. 16, 2016).

[clxiii] *See*, *e.g.*, Reperant, et al., Highly Pathogenic Avian Influenza Virus H5N1 Infection in a Long-Distance Migrant Shorebird under Migratory and Non-Migratory States, 6 PLoS ONE e27814, *4 (Nov. 2011) ("Five knots developed clinical disease or died during the experiment. Two knots inoculated during the pre-migration period exhibited severe disease, including apathy and neurological signs, such as loss of balance and tremors, and were euthanized at 5 and 6 days post inoculation (dpi). One knot inoculated during the fueling period presented torticollis and was euthanized at 6 dpi. One knot inoculated during the migration period was found dead at 11 dpi without showing clinical signs beforehand. One knot inoculated during the post-migration period exhibited neurological signs and died at 2 dpi. It had a co-infection with HPAIV H5N1 and coccal bacteria and was further excluded from the analysis because the bacterial infection contributed to severe disease and rapid death of the bird. The appearance of clinical signs in these knots was sudden and the affected birds did not behave significantly differently on the preceding days than birds that remained sub-clinically infected."); Maxted, et al., Avian Influenza Virus Infection Dynamics in Shorebird Hosts, 48 Journal of Wildlife Diseases 322 (2012), *available at* http://www.jwildlifedis.org/doi/pdf/10.7589/0090-3558-48.2.322 ; Melville, and Shortridge, Migratory waterbirds and avian influenza in the East Asian-Australasian Flyway with particular reference to the 2003-2004 H5N1 outbreak. In: Boere, G.; Galbraith, C., Stroud, D. (ed.), *Waterbirds around the world*, 432-438 (2006). The Stationary Office, Edinburgh, UK.

[clxiv] NOAA, Green Turtle, http://www.nmfs.noaa.gov/pr/species/turtles/green.html (last visited Oct. 27, 2016).

[clxv] Lawrence Herbst, Fibropapillomatosis of Marine Turtles, 4 Annual Review of Fish Diseases 389, 389 (1994), available at http://ftp.wildlifetracking.org/pdf/herbstlh_1994_annurevfishdis.pdf ; Work and Balazs, The Wildlife Society, Tumors in Sea Turtles: The Insidious Menance of Fibropapillomatosis, The Wildlife Professional Magazine, 44 (Fall 2013), *available a*t https://www.nwhc.usgs.gov/hfs/Globals/Products/Tumors-in-Sea-Turtles-Final-PDF.pdf

[clxvi] *See generally* Foley, et al., Fibropapillomatosis in stranded green turtles (Chelonia mydas) from the eastern United States (1980-98): Trends and associations with environmental factors, 41 Journal of Wildlife Diseases 29 (2005), *available at* http://www.ncbi.nlm.nih.gov/pubmed/15827208; Van Houtan, et al., Eutrophication and the dietary promotion of sea turtle tumors, *PeerJ*. DOI: 10.7717/peerj.602 (Sept. 2014), *available at* https://peerj.com/articles/602/ ; Rachel Nuwer, Pollution from Hawaii is Giving Sea Turles Gross, Deadly Tumors: Nutrient runoff gets into the turtles' food and causes tumors on thier faces, flippers and organs, Smithsonian.com (Oct. 2, 2014*), available at* http://www.smithsonianmag.com/smart-news/pollution-hawaiis-farms-and-cities-causing-sea-turtles-get-deadly-tumors-180952912/?no-ist .

[clxvii] J. Joseph, et al., Heavy Metal Compositions in Green Turtle (Chelonia mydas) eggs from nesting beaches in Peninsular Malaysia, 3 Asian Journal of Conversation Biology 83 (July 2014), available at http://www.ajcb.in/journals/short_others_july_2014/AJCB-Vol3-No1-%20Joseph%20et%20al.pdf

[clxviii] Id.

[clxix] Griffin, et al., Oceana, U.S. Sea Turtles: A Comprehensive Overview of Six Troubled Species, 28 (XXX), *available at* http://oceana.org/sites/default/files/reports/U.S._Sea_Turtles_Report_FINAL1.pdf

[clxx] *See, infra*, notes XX-XX.

[clxxi] FWS, Delmarva Peninsula Fox Squirrel, Sciurus niger cinereus, https://www.fws.gov/endangered/esa-library/pdf/squirrel.pdf (last visited Oct. 18, 2016).

[clxxii] US Department of the Interior, Delmarva Fox Squirrel Leaps off Endangered Species List (Nov. 13, 2015), available at https://www.doi.gov/pressreleases/delmarva-fox-squirrel-leaps-endangered-species-list

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[clxxvii] PBS, General Article: The Drought, http://www.pbs.org/wgbh/americanexperience/features/general-article/dustbowl-drought/ (last visited Aug. 29, 2016).

[clxxviii] *Id*.

[clxxix] Pork Checkoff, Quick Facts: America's Top 100 Pig Counties - 2012, http://www.pork.org/pork-quick-facts/home/stats/structure-and-productivity/americas-top-100-pig-counties/ (last visited Aug. 29, 2016); .

[clxxx] FWW, Factory Farm Map, Oklahoma Facts, http://www.factoryfarmmap.org/states/ok/ (last visisted Aug. 29, 2016) ("The more than 1.1 million hogs on factory farms in Texas County, Oklahoma produce as much untreated manure as the sewage from the New York City metro area.").

[clxxxi] Kerr Center for Sustainable Agriculture, Bringing Home the Bacon? The Myth of the Role of Corporate Hog Farming in Rural Revitalization, at ES-1 (2007), available at http://www.sraproject.org/wp-content/uploads/2007/12/bringinghomethebacon.pdf .

[clxxxii] World Wildlife Fund, 2016 Plowprint Report, 2 (2016), available at https://c402277.ssl.cf1.rackcdn.com/publications/946/files/original/plowprint_AnnualReport_2016_GenInfo_FINAL_112016.pdf

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[clxxxvi] Oklahoma Department of Wildlife Conservation, Whooping Crane (*Grus americana*), http://www.wildlifedepartment.com/wildlifemgmt/endangered/crane.htm (last visited Aug. 31, 2016).

[clxxxvii] Oklahoma Department of Wildlife Conservation, Endangered Cranes to Pass Through Oklahoma Soon (Oct. 20, 2015), *available at* http://www.wildlifedepartment.com/media/whoopers.htm .

[clxxxviii] Blehert, et al., USGS, Investigation of Bacterial Pathogens Associated with Concentrated Animal Feeding Operations (CAFOs) and their Potential Impacts on a National Wildlife Refuge in Oklahoma: Final Report, Project 2N44, 200120004, at 2 (July 24, 2004) .

[clxxxix] Id.

[cxc] After its listing, despite originally recognizing the need to designate an estimated 1,244 river miles as critical habitat for this imperiled little fish, FWS bowed to livestock industry pressure and in 2005 designated a mere 523 miles of rivers as its critical habitat. FWS, Press Release: Critical Habitat Proposed for the Arkansas River Shiner (Oct. 7, 2004), available at https://www.fws.gov/news/ShowNews.cfm?ref=critical-habitat-proposed-for-the-arkansas-river-shiner-&_ID=4327 ; FWS, Press Release: Critical Habitat Designated for Arkansas River Shiner (Oct. 13, 2005), available at https://www.fws.gov/mountain-prairie/pressrel/05-76.htm .

[cxci] FWS, Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Arkansas River Basin Population of the Arkansas River Shiner, 70 Fed. Reg. 59808, 59808 (Oct. 13, 2005) ("[t]he areas that [FWS] determined to possess the features that are *essential* to the conservation of the Arkansas River shiner include portions of the Canadian River (often referred to as the South Canadian River) in New Mexico, Texas, and Oklahoma, the Beaver/North Canadian River in Oklahoma, and the Cimarron River in Kansas and Oklahoma, and the Arkansas River in Kansas.") (emphasis added); *id*. (the river was excluded from the agency's final designation "under authority of section 4(b)(2) of the Act.").

[cxcii] FWS, Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for the Arkansas River Basin Population of the Arkansas River Shiner, 69 Fed. Reg. 59859, 59866 (Oct. 6, 2004) (emphasis added).

[cxciii] Id.

[cxciv] Oklahoma Dept. of Environmental Quality, Final Bacteria and Turbidity Total Maximum Daily Loads for Streams in the Beaver River Watershed, Oklahoma, at 3-15 (Sept. 2010), *available at* http://www.deq.state.ok.us/wqdnew/tmdl/beaver_river_final_bacteria_turbidity_tmdl_2010-09-08.pdf .

[cxcv] *See generally* Oklahoma Dept. of Environmental Quality, Water Quality in Oklahoma, 2014 Integrated Report (2014), *available at* http://www.deq.state.ok.us/wqdnew/305b_303d/2014/2014_OK_IR_document-Final_w_appendices.pdf ; *see also* EPA, List of Impaired Waters, https://ofmpub.epa.gov/waters10/attains_impaired_waters.control?p_cause_name=SEDIMENTATION/SILTATION&p_state=OK&p_cycle=2014&p_report_type= (last visited Aug. 30, 2016).

[cxcvi] FWS, Endangered and Threatened Wildlife and Plants; Lesser Prairie-Chicken Removed from the List of Endangered and Threatened Wildlife, 81 Fed. Reg. 47047 (July 20, 2016) The lesser prairie-chicken's listing status is currently classified as "under review." In September 2016, the Center and partners submitted an emergency petition to the Department of the Interior to re-list the lesser prairie-chicken. Center for Biological Diversity, et al., Petition to List the Lesser Prairie Chicken (Tympanuchus pallidicinctus) and Three Distinct Population Segments Under the U.S. Endangered Species Act and Emergency Listing Petition for the Shinnery Oak Prairie and Sand Sage Prairie Distinct Population Segments (Sept. 8, 2016), *available at* http://www.wildearthguardians.org/site/DocServer/LPC_petition_2016_final_opt_2.pdf . On November 29, 2016, FWS completed its initial review of the emergency listing petition, and found that it presented substantial

information that the requested listing action may be warranted. FWS, Petitions to Federally Protect the Lesser Prairie-Chicken, Increase Protections for Leopard Move Forward to Next Review Phase (Nov. 29, 2016), available at https://www.fws.gov/news/ShowNews.cfm?ref=petitions-to-federally-protect-the-lesser-prairie-chicken-increase--&_ID=35899 .

[cxcvii] *Id*.

[cxcviii] FWS, Petitions to Federally Protect the Lesser Prairie-Chicken, Increase Protections for Leopard Move Forward to Next Review Phase (Nov. 29, 2016), available at https://www.fws.gov/news/ShowNews.cfm?ref=petitions-to-federally-protect-the-lesser-prairie-chicken-increase--&_ID=35899 .

[cxcix] USDA, Lesser Prairie-Chicken Initiative, http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/home/?cid=nrcsdev11_023912 (last visited Oct. 24, 2016).

[cc] Center for Biological Diversity, et al., Petition to List the Lesser Prairie Chicken (Tympanuchus pallidicinctus) and Three Distinct Population Segments Under the U.S. Endangered Species Act and Emergency Listing Petition for the Shinnery Oak Prairie and Sand Sage Prairie Distinct Population Segments, at 14 (Sept. 8, 2016), available at http://www.wildearthguardians.org/site/DocServer/LPC_petition_2016_final_opt_2.pdf; see also ft. nt. [cc] , supra .

[cci] FWS, Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Lesser Prairie-Chicken, 79 Fed. Reg. 19974, 19974 (Apr. 10, 2014).

[ccii] *Id*. at 20026 (citations omitted).

[cciii] S. Faber, et al., Plowed Under, 3 (2012), available at http://www.ewg.org/node/15941.

[cciv] *Id*. at 6, 8.

[ccv] *See generally* Clark & Tilman, Loss of plant species after chronic low-level nitrogen deposition to prairie grasslands, 451 Nature 712 (2008); Stevens, et al., Anthropogenic Nitrogen Deposition Predicts Local Grassland Primary Production Worldwide, 96 Ecology 1459 (2015), *available at* http://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1052&context=pss_facpub ; Payne, et al., Impact of Nitrogen Deposition at the Species Level, 110 PNAS 984 (Jan. 15, 2013), *available at* http://www.pnas.org/content/110/3/984.full.pdf .

[ccvi] Center for Biological Diversity , et al., Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States as Threatened or Endangered Under the Endangered Species Act, at 5 (Apr. 20, 2010).

[ccvii] Center for Biological Diversity , et al., Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States as Threatened or Endangered Under the Endangered Species Act, at 5 (Apr. 20, 2010).

[ccviii] Suzi Parker, How Poultry Producers are Ravaging the Rural South, Grist (Feb. 22, 2006), *available at* http://grist.org/article/parker1/ ("In Arkansas alone, chicken farms produce an amount of manure each day equal to that produced by 8 million people.").

[ccix] Peterson, et al., 17 β-Estradiol as an Indicator of Animal Waste Contamination in Mantled Karst Aquifers, 29 Journal of Environmental Quality 826, 827 (2000).

[ccx] Peterson, et al., 17 β-Estradiol as an Indicator of Animal Waste Contamination in Mantled Karst Aquifers, 29 Journal of Environmental Quality 826, 827 (2000).

[ccxi] GAO CAFO Report at 22.

[ccxii] *Id*.

[ccxiii] Arkansas Dept. of Environmental Quality, 2004 Integrated Water Quality Monitoring and Assessment Report, 5 (2005), *available at* https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2004/305b-integrated-report.pdf ; *see also* National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, 66 Fed. Reg. 2960, 2980-81 (Jan. 12, 2001) ("According to Arkansas' 1996 Water Quality Inventory Report, a publication of the Arkansas Department of Environmental Protection, water in the Grand Neosho basin only partially supports aquatic life. Land uses there, primarily confined animal feeding operations including poultry production and pasture management, are major sources of nutrients and chronic high turbidity. Pathogens sampled in the Muddy Fork Hydrologic Unit Area, in the Arkansas River basin, also exceed acceptable limits for primary contact recreation (swimming). This problem was reported in the 1994 water quality inventory, and it, too, was traced to extensive poultry, swine, and dairy operations in the Moore's Creek basin. Essentially, all parts of the subwatershed are impacted by these activities.")

[ccxiv] Arkansas Dept. of Environmental Quality, 2004 Integrated Water Quality Monitoring and Assessment Report, 5 (2005), *available at* https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2004/305b-integrated-report.pdf ; *see also* National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, 66 Fed. Reg. 2960, 2980-81 (Jan. 12, 2001) ("According to Arkansas' 1996 Water Quality Inventory Report, a publication of the Arkansas Department of Environmental Protection, water in the Grand Neosho basin only partially supports aquatic life. Land uses there, primarily confined animal feeding operations including poultry production and pasture management, are major sources of nutrients and chronic high turbidity. Pathogens sampled in the Muddy Fork Hydrologic Unit Area, in the Arkansas River basin, also exceed acceptable limits for primary contact recreation (swimming). This problem was reported in the 1994 water quality inventory, and it, too, was traced to extensive poultry, swine, and dairy operations in the Moore's Creek basin. Essentially, all parts of the subwatershed are impacted by these activities.")

[ccxv] *Id*. at 139; *see also* Graening and Brown, Ecosystem Dynamics and Pollution Effects in an Ozark Cave Stream, XX Journal of the American Water Resources Association 1497, 1498 (Dec. 2003), *available at* http://www.csus.edu/indiv/g/graeningg/pubs/jawra_39_6_1497-1507.pdf
("The Ozark Plateaus consist of fractured and dissolved carbonate bedrock (karst) that store significant quantities of ground water. These aquifers are a major water resource for northern Arkansas and are highly susceptible to organic pollution from land application of animal wastes and other waste disposal practices because karst landscapes allow rapid infiltration of surface pollutants to ground water With ample annual rainfall (more than 1 m accumulation), extensive use of septic systems, and intensive agricultural animal production (e.g., 1 billion poultry produced per year in Arkansas), northern Arkansas' ground water is chronically contaminated, particularly with excess nutrients and coliform bacteria.") (citations omitted).

[ccxvi] https://www.fws.gov/southeast/species/invertebrate/docs/Factsheet_neosho_mucket_and_rabbitsfoot_april2015.pdf

[ccxvii] https://www.fws.gov/midwest/endangered/clams/neoshomucket/index.html ; U.S. FWS, Final Environmental Assessment for Designation of Critical Habitat for Neosho mucket and Rabbitsfoot Mussels, 3 (Sept. 2014), *available at* https://www.fws.gov/southeast/species/invertebrate/docs/NEPA_EA_Neosho%20mucket_Rabbitsfoot_fCH.pdf

[ccxviii] U.S. FWS, Final Environmental Assessment for Designation of Critical Habitat for Neosho mucket and Rabbitsfoot Mussels, 58-59, 70 (Sept. 2014), *available at* https://www.fws.gov/southeast/species/invertebrate/docs/NEPA_EA_Neosho%20mucket_Rabbitsfoot_fCH.pdf

[ccxix] Sediment is material suspended in water that usually is moved as the result of erosion. Although sedimentation is a natural process, poor land use practices accelerate erosion and increase sedimentation.

[ccxx] *Id*. at 58; U.S. FWS, Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for both Species; Proposed Rule, 77 Fed. Reg. 63440, 63479 (Oct. 16, 2012) ("The PBFs in this unit may require special management

considerations or protection to address changes in stream channel stability associated with urban development and clearing of riparian areas due to land use conversion in the watershed; alteration of water chemistry or water and sediment quality; and changes in stream bed material composition and quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, confined animal operations, and timber harvesting."); J Brim Box & J Mossa, Sediment, Land Use, and Freshwater Mussels: Prospects and Problems, 18 North American Benthological Society 99 (Mar. 1999), *available at* http://www.jstor.org/stable/1468011

[ccxxi] Naimo, 1995 https://www.researchgate.net/publication/258336826_A_Review_of_the_Effects_of_Heavy_Metals_on_Freshwater_Mussels

[ccxxii] U.S. FWS, Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for both Species; Proposed Rule, 77 Fed. Reg. 63440, 63459 (Oct. 16, 2012).

[ccxxiii] U.S. FWS, Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for both Species; Proposed Rule, 77 Fed. Reg. 63440, 63455 (Oct. 16, 2012) (The rabbitsfoot "is presently extant in 51 of the 140 streams of historical occurrence, a 64 percent decline."); Center for Biological Diversity , et al., Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States as Threatened or Endangered Under the Endangered Species Act, at 1022 (Apr. 20, 2010).

[ccxxiv]U.S. FWS, Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for both Species; Proposed Rule, 77 Fed. Reg. 63440, 63455 (Oct. 16, 2012) ("The habitats of freshwater mussels are vulnerable to water quality degradation and habitat modification from a number of activities associated with modern civilization. The decline, extirpation, and extinction of mussel species are often attributed to habitat alteration and destruction linked the decline and extinction of mussels to a wide variety of threats including siltation, industrial and municipal effluents, modification of stream channels, impoundments, pesticides, heavy metals, invasive species, and the loss of host fish."); *id*. at 63480 ("The PBFs in units RF1 through RF32 may require special management considerations to address changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal; alteration of water chemistry or water quality; and changes in stream bed material composition and sediment quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, confined animal operations (turkey and chicken), timber harvesting, and mining, and releases of chemical contaminants from industrial and municipal effluents.")

[ccxxv] Center for Biological Diversity , et al., Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States as Threatened or Endangered Under the Endangered Species Act, at 1023 (Apr. 20, 2010).

[ccxxvi] https://www.biologicaldiversity.org/news/press_releases/2015/freshwater-mussels-04-29-2015.html

[ccxxvii] FWS, Endangered and Threatened Wildlife and Plants; Endangered Status Determined for the Cave Crayfish (*Cambarus aculabrum)*, 58 Fed. Reg. 25742, 25745 (Apr. 27, 1993) ("This crayfish, however, is only known to occur in two caves, and has never been reported from any other cave systems despite substantial surveys."); https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=K02J

[ccxxviii] FWS, Endangered and Threatened Wildlife and Plants; Endangered Status Determined for the Cave Crayfish (*Cambarus aculabrum)*, 58 Fed. Reg. 25742, 25745 (Apr. 27, 1993).

[ccxxix] U.S. FWS, Recovery Plan for the Cave Crayfish (*Cambarus aculabrum)*, 5 (1993), *available at* https://ecos.fws.gov/docs/recovery_plan/961030.pdf ("This species is known from only two cave sites in northwest Arkansas.... The water quality of Logan Cave [one of those caves] is primarily threatened by hog and poultry

operations adjacent to or within the groundwater recharge area (Aley and Aley 1987). These operations produce large amounts of animal waste which if not disposed of properly may contaminate Logan Cave Stream and aquifer. The practice of using liquid animal waste to fertilize pasture lands in the Logan Cave recharge area can also cause water contamination when the fertilizer is improperly applied or if heavy precipitation follows application."); FWS, Endangered and Threatened Wildlife and Plants; Endangered Status Determined for the Cave Crayfish (*Cambarus aculabrum)*, 58 Fed. Reg. 25742, 25743 (Apr. 27, 1993) ("The Service considers poultry and swine operations in the vicinity of the Logan Cave recharge area as a principal potential source for both point and nonpoint source groundwater contamination.").

> [ccxxx] *See, e.g.* FWS, Benton County Cave Crayfish (*Cambarus aculabrum* Hobbs and Brown 1987); 5-Year Review: Summary and Evaluation, at 8 (2013), *available at* https://www.fws.gov/southeast/5yearreviews/5yearreviews/bentoncountycavecrawfish_.pdf ("Two major land use activities occur in the Logan Cave recharge area: residential and commercial development and agriculture. Problems associated with these land uses include elevated nutrient concentrations, pesticides, and varied contaminants yielded from storm water runoff (Aley and Aley 1987; USFWS 2008). Numerous cattle, swine, and poultry farms operate within the recharge area and produce substantial quantities of animal waste. Land application of animal waste is commonly used as fertilizer to enhance pasture production. Leaks and spills associated with increased road density in the recharge area increases the likelihood of water quality contaminants entering the cave system."); *id*. at 11 ("Arkansas enacted legislation, whereby land application of poultry litter must be conducted under an approved nutrient management plan. That plan is based on soil and vegetative communities present, and recommends distances from waterways where litter should be applied. As enforcement is limited and water quality in caves and wells show increases in nutrients and metals, it appears adherence to or success of these plans is limited."); Simon & Buikema, Effects of Organic Pollution on an Appalachian Cave: Changes in Macroinvertebrate Populations and Food Supplies, 138 The American Midland Naturalist 387 (1997), *available at* http://www.jstor.org/stable/2426830?seq=1#page_scan_tab_contents ; *see also* Peterson, et al., 17 β-Estradiol as an Indicator of Animal Waste Contamination in Mantled Karst Aquifers, 29 Journal of Environmental Quality 826, 833 (2000).

[ccxxxi] https://ecos.fws.gov/docs/five_year_review/doc4153.pdf

[ccxxxii] Encyclopaedia Britannica, Snake River, https://www.britannica.com/place/Snake-River (last visited Aug. 29, 2016).

[ccxxxiii] National Wild and Scenic Rivers System, Snake River, Idaho, Oregon, https://www.rivers.gov/rivers/snake.php (last visited Aug. 29, 2016).

[ccxxxiv] Numerous species of native fish and other aquatic species have already been anthropogenically extirpated from the Middle Snake River, including: chinook salmon (*Onchorhynchus tshawytscha*), coho salmon (*O. kisutch*), steelhead trout (*O. mykiss*), and Pacific lamprey (*Lampetra tridentata*). EPA, Ecological Risk Assessment for the Middle Snake River, Idaho, Report No. EPA/600/R-01/017, at B-4 (2002); see also id. at 1-1 ("biological changes [to the Middle Snake River] include loss of native macroinvertebrate species, invasion and dominance by exotic species, extirpation of native fish species, expansion of pollution-tolerant organisms, and excessive growth of aquatic plants and algae. The increasing demand for energy, irrigation resources, springs, and dairy feedlots projected for this region will place additional burdens on an ecosystem that human activity has already substantially changed."). The same fate must not befall the aquatic species discussed herein.

[ccxxxv] *Id*.

[ccxxxvi] National Agricultural Statistics Service, USDA, 2012 Census of Agriculture, at 271 (2014), https://agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf.

[ccxxxvii] Twilight Greenaway, Forget Potatoes: Idaho Now Grows CAFOs, Grist (Aug. 26, 2011), available at http://grist.org/factory-farms/2011-08-25-forget-potatoes-idaho-now-grows-cafos/; Scott Weaver, Cow Country:

The Rise of the CAFO in Idaho, Boise Weekly (Sept. 01, 2010), available at http://www.boiseweekly.com/boise/cow-country-the-rise-of-the-cafo-in-idaho/Content?oid=1755457 .

[ccxxxviii] Food & Water Watch, www.factoryfarmmap.org (last visited Jun. 6, 2016).

[ccxxxix] Twilight Greenaway, Forget Potatoes: Idaho Now Grows CAFOs, Grist (Aug. 26, 2011), available at http://grist.org/factory-farms/2011-08-25-forget-potatoes-idaho-now-grows-cafos/ (estimating that milk production has grown from 2,000 dairies producing approximately 3 billion pounds of milk in 1991 to current estimates of just 650 dairies producing an estimated 11 billion pound of milk a year.).

[ccxl] Twilight Greenaway, Forget Potatoes: Idaho Now Grows CAFOs, Grist (Aug. 26, 2011), available at http://grist.org/factory-farms/2011-08-25-forget-potatoes-idaho-now-grows-cafos/; Scott Weaver, Cow Country: The Rise of the CAFO in Idaho, Boise Weekly (Sept. 1, 2010), available at http://www.boiseweekly.com/boise/cow-country-the-rise-of-the-cafo-in-idaho/Content?oid=1755457.

[ccxli] FWS, Endangered and Threatened Wildlife and Plants; 12-Month Findings on a Petition to Remove the Bliss Rapids Snail (Taylorconcha serpenticola) from the List of Endangered and Threatened Wildlife, 74 Fed. Reg. 47536, 47536 (Sept. 16, 2009).

[ccxlii] FWS, Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Five Aquatic Snails in South Central Idaho, 57 Fed. Reg. 59244, 59252 (Dec. 14, 1992).

[ccxliii] FWS, Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Five Aquatic Snails in South Central Idaho, 57 Fed. Reg. 59244, 59245 (Dec. 14, 1992); *id*. at 59253.

[ccxliv] "Critical habitat," as the term is used in the Endangered Species Act, has not yet been designated for this species.

[ccxlv] FWS, Bliss Rapids Snail to Remain on Federal List of Endangered and Threatened Wildlife (Sept. 16, 2009), available at https://www.fws.gov/news/ShowNews.cfm?ref=bliss-rapids-snail-to-remain-on-federal-list-of-endangered-and-threatened-w&_ID=358 ; FWS, Endangered and Threatened Wildlife and Plants; 12-Month Findings on a Petition to Remove the Bliss Rapids Snail (Taylorconcha serpenticola) from the List of Endangered and Threatened Wildlife, 74 Fed. Reg. 47536, 47538 (Sept. 16, 2009).

[ccxlvi] Idaho Department of Environmental Quality, Summary Report: Ground Water Quality Monitoring Projects - 2010, Ground Water Quality Technical Report No. 44, at 62 (2013), available at http://www.deq.idaho.gov/media/940325-ground_water_monitoring_report_2010_44.pdf ; see also Idaho Department of Environmental Quality, Possible Sources of Nitrate to the Springs of Southern Gooding County, Eastern Snake River Plain, Idaho, Ground Water Quality Technical Report No. 38, 15 (2009), available at https://www.deq.idaho.gov/media/471155-_water_data_reports_ground_water_southern_gooding_county_nitrate_38.pdf ("A nitrogen loading analysis for the western part of the ESRP found the largest potential source of nitrogen in the area was nitrogen from fertilizer applications (47%). Other substantial sources of nitrogen were from dairy, beef, and other confined animal operations (43%).")(citations omitted).

[ccxlvii] Idaho Department of Environmental Quality, The Eastern Snake River Plain Aquifer, State of Idaho Oversight Monitor, 1 (May 2005), available at https://www.deq.idaho.gov/media/552772-newsletter_0505.pdf ; id. at 5 ("About 86% of the water going out of the aquifer ... eventually flows into the Snake River.").

[ccxlviii] Id.

[ccxlix] EPA, Ecological Risk Assessment for the Middle Snake River, Idaho, Report No. EPA/600/R-01/017, at 7-11 (2002).

[ccl] FWS, Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Five Aquatic Snails in South Central Idaho, 57 Fed. Reg. 59245, 59246 (Dec. 14, 1992).

[ccli] FWS, Banbury Springs Lanx (Lanx n. sp.) (undescribed) 5-Year Review: Summary and Evaluation, 4 (2006), available at https://www.fws.gov/pacific/ecoservices/endangered/recovery/documents/banburyspringslanx5-yearreview_000.pdf .

[cclii] Id; *see also* EPA, Ecological Risk Assessment for the Middle Snake River, Idaho, Report No. EPA/600/R-01/017, at 7-12 (2002).

[ccliii] *See supra* at note 21.

[ccliv] FWS, Banbury Springs Lanx (Lanx n. sp.) (undescribed) 5-Year Review: Summary and Evaluation, 11 (2006), *available at* https://www.fws.gov/pacific/ecoservices/endangered/recovery/documents/banburyspringslanx5-yearreview_000.pdf .

[cclv] *Id*. at 14; *see also* Idaho Department of Environmental Quality, 2005 Update, Thousand Springs Area of the Eastern Snake River Plain, Idaho, Ground Water Quality Technical Report No. 27, 40 (2006), *available at* https://www.deq.idaho.gov/media/470724-_water_data_reports_ground_water_thousand_springs_2005_update_27.pdf (43 percent of estimated nitrogen loads. in this study area determined to come from animal waste from dairy, beef, and other cattle operations)

[cclvi] EPA, Ecological Risk Assessment for the Middle Snake River, Idaho, Report No. EPA/600/R-01/017, at 7-9 (2002).

[cclvii] *Id*.; FWS, Snake River Aquatic Species Recovery Plan, 8 (1995), *available at* https://ecos.fws.gov/docs/recovery_plan/951126.pdf .

[cclviii] EPA, Ecological Risk Assessment for the Middle Snake River, Idaho, Report No. EPA/600/R-01/017, at 7-10 (2002).

[cclix] FWS, Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Five Aquatic Snails in South Central Idaho, 57 Fed. Reg. 59245, 59254 (Dec. 14, 1992); s*ee generally* FWS, Snake River Aquatic Species Recovery Plan (1995), *available at* https://ecos.fws.gov/docs/recovery_plan/951126.pdf .

[cclx] Id.

[cclxi] EPA, Relations Between Nitrate in Water Wells and Potential Sources in the Lower Yakima Valley, Washington, EPA-910-R-13-004, at ES-1 (2013); *id* at ES-9 ("Nitrate levels above EPA's drinking water standard in residential drinking water wells in the Lower Yakima Valley are well documented."); *see also* Leah War, Hidden Wells, Dirty Water, *Yakima Herald-Republic* (Oct. 12, 2008).

[cclxii] *Id*. at ES-9.

[cclxiii] *See generally id.*

[cclxiv] *Id*. at 40.

[cclxv] *Id*. at 45.

[cclxvi] *Id*. at 61.

[cclxvii] *See, e.g.,* USGS, Assessment of Eutrophication in the Lower Yakima River Basin, Washington, 2004-07, Scientific Investigation Report 2009 -5078, at 6 (2009) ("Although some nutrients enter the lower Yakima River directly from wastewater treatment plants, most nutrients come from diffuse sources such as atmospheric deposition, runoff and leaching from fertilizer application and animal waste, urban runoff, decay of vegetation, and septic system effluent. Nutrients from diffuse sources are delivered to the Yakima River through tributaries, irrigation

return flows, overland runoff, and ground water."); Gibson and Schwab, Detection of Bacterial Indicators and Human and Bovine Enteric Viruses in Surface Water and Groundwater Sources Potentially Impacted by Animal and Human Wastes in Lower Yakima Valley, Washington, 77 Applied and Environmental Microbiology 355, 355 (2011); Linda Thompson, A Breath of Fresh Air: Methods and Obstacles for Achieving Air Pollution Reduction in Washington Factory Farm Communities, 1 Washington Journal of Environmental Law & Policy 130, 139 (2011) ("in the Yakima Valley, residents have complained of vomiting from the amount of fecal material in the air, and the asthma rate is thirty-three percent higher in the area than in the rest of the state of Washington. The Yakama Nation Asthma Awareness Project was recently awarded one of nine EPA grants because of the heightened rate of asthma on the reservation. At low levels, ammonia and hydrogen sulfide can cause eye, nose, and throat irritation and burns, and the gases can be lethal at high, short-term levels. Permanent, longterm effects of hydrogen sulfide exposure include irritation of asthma, headaches, and poor memory and motor function. In addition, PM can be deposited in the respiratory tract, which contributes to lung and breathing problems and cardiovascular disease.") (citations omitted); *see also Community Assoc. for Restoration of the Environ.*, 80 F. Supp. 3d 1180, 1199 (E.D. Wash. 2015) (finding that dairy's operations involving use of manure may present an imminent and substantial endangerment to the public in violation of the Resources Conservation and Recovery Act).

[cclxviii] NOAA, 2016 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead, at 9-10 (2016), *available at* http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_middle-columbia.pdf

[cclxix] *See, e.g.*, Yakima Basin Fish & Wildlife Recovery Board, Yakima Steelhead Recovery Plan Extracted from the 2005 Yakima Subbasin Salmon Recovery Plan with Updates, *107 (2009), *available at* http://www.ybfwrb.org/Assets/Documents/Plans/YakimaSteelheadPlan.pdf ("Degraded water quality (especially pH, dissolved oxygen [DO], and temperature conditions) significantly reduces habitat quality in the lower Yakima. Intensive agricultural production, including drainage improvements, and the use of fertilizers and pesticides have left a legacy of contamination ..., and residual concentrations of nutrients."); NOAA, Pacific Salmonids Major Threats and Impacts, http://www.nmfs.noaa.gov/pr/species/fish/salmon.html (last visited Aug. 22, 2016).

[cclxx] Id.

[cclxxi] *See* USGS, Assessment of Eutrophication in the Lower Yakima River Basin, Washington, 2004-07, Scientific Investigation Report 2009 -5078, at 6 (2009).

[cclxxii] *See generally* K. Carter, California Regional Water Quality Control Board, The Effects of Dissolved Oxygen on Steelhead Trout, Coho Salmon, and Chinook Salmon Biology and Function by Life Stage (2005), *available at* http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/shasta_river/060707/29appendixbetheeffectsofdissolvedoxygenonsteelheadtroutcohosalmonandchinooksalmonbiologyandfunction.pdf

[cclxxiii] NOAA, 2016 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead, at 39-40 (2016), *available at* http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_middle-columbia.pdf ; NMFS, Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan, 7-1 (Nov. 30, 2009), *available at* http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/middle_columbia/mid-c-plan.pdf ("If, as we believe, the decline of the Middle Columbia River steelhead DPS is caused by widespread habitat degradation, impaired mainstem and tributary passage, hatchery effects, and predation/ competition/ disease, then actions taken to improve, change, mitigate, reduce those factors will result in reduced risks and increased survival. Because of the steelhead's complex life cycle and the many changes that have taken place in its environment, the factors limiting its survival must be addressed in concert, and in an integrated way.")

[cclxxiv] FWS, Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States, 75 Fed. Reg. 63898, 63898 (Oct. 18, 2010).

[cclxxv] Reiss, et al., Yakima Bull Trout Action Plan, at 1 (2012), available at http://www.ybfwrb.org/Assets/Documents/Plans/YBTAP%209-2012%20FINAL-small.pdf

[cclxxvi] FWS, Mid-Columbia Recovery Unit Implementation Plan for Bull Trout, at C-15 - C-17 (2015), available at http://ecos.fws.gov/docs/recovery_plan/Final_Mid_Columbia_RUIP_092915.pdf

[cclxxvii] FWS, Mid-Columbia Recovery Unit Implementation Plan for Bull Trout, at C-15 (2015), available at http://ecos.fws.gov/docs/recovery_plan/Final_Mid_Columbia_RUIP_092915.pdf

[cclxxviii] *See generally* Reiss, et al., Yakima Bull Trout Action Plan (2012), available at http://www.ybfwrb.org/Assets/Documents/Plans/YBTAP%209-2012%20FINAL-small.pdf; see also id. at 10 ("The Yakima River basin is a rich agricultural area almost totally dependent on irrigation. It contains about 500,000 acres of irrigated land with the water for most of this acreage supplied by the USBR's Yakima Project. Other major land uses include livestock production (ranching, feedlots, and dairies), timber production, and recreation.")

[cclxxix] Bowerman, et al., Effects of fine sediment, hyporheic flow, and spawning site characteristics on survival and development of bull trout embryos, 71 Canadian Journal of Fisheries and Aquatic Sciences 1059 (2014), available at https://www.researchgate.net/profile/Tracy_Bowerman/publication/264003910_

[cclxxx] The Cornell Lab of Ornithology, All About Birds, Yellow-billed Cuckoo, https://www.allaboutbirds.org/guide/Yellow-billed_Cuckoo/lifehistory (last visited Oct. 25, 2016).

[cclxxxi] The Cornell Lab of Ornithology, All About Birds, Yellow-billed Cuckoo, https://www.allaboutbirds.org/guide/Yellow-billed_Cuckoo/lifehistory (last visited Oct. 25, 2016).

[cclxxxii] Id.

[cclxxxiii] FWS, Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus); Final Rule, 79 Fed. Reg. 59992, 59992 (Oct. 3, 2014); FWS, Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus); Proposed Rule, 78 Fed. Reg. 61622, 61647 (Oct. 3, 2013).

[cclxxxiv] FWS, Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus); Proposed Rule, 78 Fed. Reg. 61622, 61633 (Oct. 3, 2013).

[cclxxxv] The Arizona Experience, American Indian Tribes and Communities in Arizona, http://arizonaexperience.org/people/indian-tribes-and-communities (last visited Sept. 1, 2016).

[cclxxxvi] USDA, 2012 Census of Agriculture, County Profile: Maricopa County (xxxx), *available at* https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Arizona/cp04013.pdf (Maricopa County is ranked 11th nationally in milk sales.); USDA, 2012 Census of Agriculture, County Profile: Pinal County (xxxx), *available at* https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Arizona/cp04021.pdf (Pinal County is ranked 17th nationally in milk sales.).

[cclxxxvii] See, e.g., Shamrock Farms, About Us, Our Farm, https://www.shamrockfarms.net/about-us/our-farm/ (last visited Aug. 31, 2016).

[cclxxxviii] *See, supra*, note 5.

[cclxxxix] U.S. Climate Data, Arizona, http://www.usclimatedata.com/climate/arizona/united-states/3172 (last visited Oct. 25, 2016); Weatherdb.com, Phoenix, Arizona Average Rainfall, https://rainfall.weatherdb.com/l/27/Phoenix-Arizona (last visited Oct. 25, 2016).

[ccxc] National Public Radio, Morning Edition, Saudi Hay Farm in Arizona Tests State's Supply of Groundwater (Nov. 2, 2015), *available at* http://www.npr.org/sections/thesalt/2015/11/02/453885642/saudi-hay-farm-in-arizona-tests-states-supply-of-groundwater ; see also Associated Press, Saudi Land Purchases in California and Arizona Fuel Debate over Water Rights, Los Angeles Times (Mar. 29, 2016), *available at* http://www.latimes.com/business/la-fi-saudi-arabia-alfalfa-20160329-story.html ("Despite the widespread drought conditions, the U.S. is attractive to water-seeking companies because it has strong legal protections for agriculture, even though the price of land is higher than in other places.").

[ccxci] National Public Radio, Morning Edition, Saudi Hay Farm in Arizona Tests State's Supply of Groundwater (Nov. 2, 2015), *available at* http://www.npr.org/sections/thesalt/2015/11/02/453885642/saudi-hay-farm-in-arizona-tests-states-supply-of-groundwater

[ccxcii] *See generally* Arizona Dept. of Environmental Quality, San Pedro River E. coli TMDL, Reach # 15050203-001 (Aug, 2013), *available at* http://legacy.azdeq.gov/environ/water/assessment/download/sp_e.coli_tmdl.pdf

[ccxciii] FWS, Endangered and Threatened Wildlife and Plants; Threatened Status for the Northern Mexican Gartersnake and Narrow-Headed Gartersnake, 79 Fed. Reg. 38678, 38679 (July 8, 2014).

[ccxciv] I*d*. at 38704; *see also id.* at 38706 ("The best available scientific and commercial information indicates that any reduction in the presence or availability of water is a significant threat to northern Mexican and narrowheaded gartersnakes, their prey base, and their habitat. This is because water is a fundamental need that supports the necessary aquatic and riparian habitats and prey species needed by both species of gartersnake.").

[ccxcv] *Id*. at 38679.

[ccxcvi] FWS, Endangered and Threatened Wildlife and Plants; Threatened Status for the Northern Mexican Gartersnake and Narrow-Headed Gartersnake, 79 Fed. Reg. 38678, 38678 (July 8, 2014).

[ccxcvii] *Id*. at 38704.

[ccxcviii] See, e.g., id. at 38714 ("A significant reduction or absence of a prey base results in stress of resident gartersnake populations and can result in local population extirpations."); id. at 38711 ("Fish kills, also discussed below, can drastically affect the suitability of habitat for northern Mexican and narrow-headed gartersnakes due to the removal of a portion or the entire prey base.").

[ccxcix] FWS, Endangered and Threatened Wildlife and Plants; the Razorback Sucker (Xyrauchen texanus) Determined to be an Endangered Species, 56 Fed. Reg. 54957, 54949 (Oct. 23, 1991).

[ccc] *Id*. at 54962

[ccci] FWS, Endangered and Threatened Wildlife and Plants; the Razorback Sucker (Xyrauchen texanus) Determined to be an Endangered Species, 56 Fed. Reg. 54957, 54957 (Oct. 23, 1991).

[cccii] FWS, Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub, 59 Fed. Reg. 13374, 13374 (Mar. 21, 1994).

[ccciii] FWS, Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Southwestern Willow Flycatcher, 78 Fed. Reg. 344, 345 (Jan. 3, 2013).

[ccciv] FWS, Endangered and Threatened Wildlife and Plants; Final Rule Determining Endangered Status for the Southwestern Willow Flycatcher, 60 Fed. Reg. 10694, 10698 (Feb. 27, 1995).

[cccv] FWS, Endangered and Threatened Wildlife and Plants; Final Rule Determining Endangered Status for the Southwestern Willow Flycatcher, 60 Fed. Reg. 10694, 10707 (Feb. 27, 1995).

[cccvi] *Id*.

[cccvii] FWS, Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Southwestern Willow Flycatcher, 78 Fed. Reg. 344, 357 (Jan. 3, 2013).

[cccviii] The Bald Eagle has been delisted due to recovery, but its populations remain under threat.

[cccix] All farm animal population numbers in the report from the 2012 Census of Agriculture. USDA, 2012 Census of Agriculture (2014), *available at* https://www.agcensus.usda.gov/Publications/2012/. All animal and human waste projections are based on estimates provided by the U.S. Environmental Protection Agency. EPA, Risk Assessment Evaluation for Concentrated Animal Feeding Operations, EPA/600/R-04/042 , Table 3.3 (2004).