NO REFUGE

How America's national wildlife refuges are needlessly sprayed with nearly half a million pounds of pesticides each year

Hannah Connor • Center for Biological Diversity • May 2018

Lower Klamath Lake, Klamath Basin National Wildlife Refuge by Michael McCullough, CC-BY-NC

EXECUTIVE SUMMARY

America's 562 national wildlife refuges play a critical role in protecting fish, plants and other wildlife. The refuges include forests, wetlands and waterways vital to thousands of species of plants and animals, including 280 that are protected under the Endangered Species Act.

Yet private industrial-scale commercial farming of crops like corn, soybeans and sorghum has become common on refuge lands, triggering the escalating use of highly toxic pesticides and pesticide-treated seeds that threaten the long-term health of these sensitive habitats and the wildlife that depend on them.

For this report we examined records we obtained, via the Freedom of Information Act, from the U.S. Fish and Wildlife Service. These records reveal extensive pesticide use for commercial agriculture on national wildlife refuges.

Key finding: More than 490,000 pounds of dangerous pesticides were used for agricultural purposes on national wildlife refuges in 2016, including highly toxic herbicides like dicamba and 2,4-D that are particularly harmful to endangered species and migrating birds. The 2016 use was consistent with pesticide applications over the previous two years.

Pesticides applications for agricultural use were spread across more than 270,000 acres in 2016. The five national wildlife refuge complexes[1] in which pesticides were most applied for agricultural purposes in 2016 were:

- Klamath Basin National Wildlife Refuge Complex[2] in California and Oregon, which allowed 236,966 pounds of pesticides to be applied;
- Central Arkansas Refuge Complex[3] in Arkansas, which allowed 48,725 pounds of pesticides to be applied;
- West Tennessee Refuge Complex[4] in Tennessee, which allowed 22,044 pounds of pesticides to be applied;
- Tennessee National Wildlife Refuge Complex[5] in Tennessee, which allowed 16,615 pounds of pesticides to be applied;
- Chesapeake Marshlands National Wildlife Refuge Complex[6] on the Eastern Shore of Maryland and Virginia, which allowed 16,442 pounds of pesticides to be applied.

Additional Findings:

Lake deer at Wapanocca National Wildlife Refuge, Central Arkansas Refuge Complex, courtesy USFWS

- Aerial pesticide spraying: In 2016, 107,342 acres of refuge lands were aerially sprayed with 127,020 pounds of pesticides for agricultural purposes, including approximately 1,328 pounds of the notoriously drift-prone dicamba, which is extremely toxic to fish, amphibians and crustaceans.
- Glyphosate: In 2016 more than 55,000 agricultural acres in the refuge system were treated with 116,200 pounds of products containing glyphosate, the pesticide that has caused widespread decreases in milkweed plants, helping to trigger the 80 percent population decline of monarch butterflies over the past two decades.
- 2,4-D: In 2016 more than 12,000 refuge acres were treated with 15,819 pounds of pesticide products containing 2,4-D, which is known to be toxic to mammals, birds, amphibians, crustaceans, reptiles and fish and is likely to jeopardize the continued existence of endangered and threatened salmonids.
- Paraquat dichloride: In 2016 more than 3,000 acres of corn and soybean crops on refuge lands were treated, mainly through aerial spraying, with approximately 6,800 pounds of pesticides containing paraquat dichloride, which is known to be toxic to crustaceans, mammals, fish, amphibians and mollusks and is so lethal it is banned in 32 countries, including the European Union.

RECOMMENDATIONS

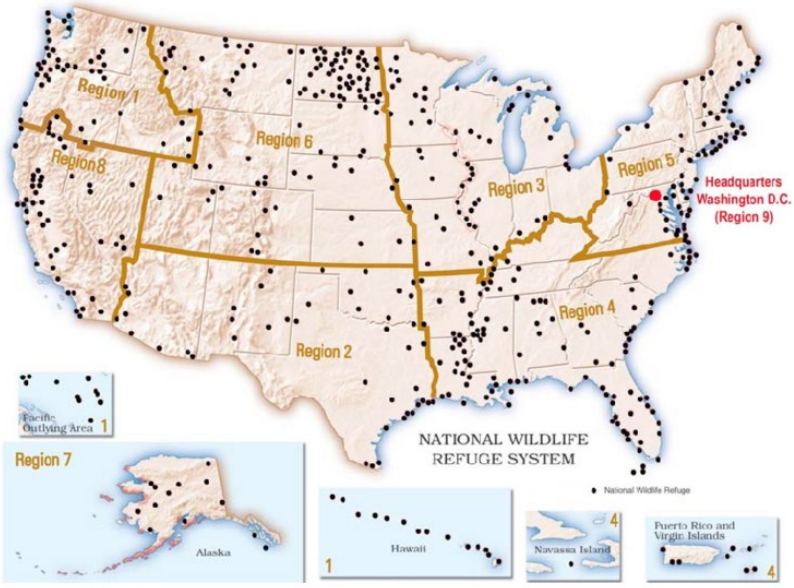
The widespread use of pesticides for private agricultural purposes on national wildlife refuges conflicts with the mission of the refuge system and creates a legacy of chemical pollution that threatens the long-term health of these essential ecosystems.

To ensure the preservation of the biological integrity, species diversity and overall health of the national wildlife refuges, the use of dangerous pesticides for commercial agricultural purposes should be discontinued.

INTRODUCTION

Each national wildlife refuge was created by congressional action, an executive action of the president of the United States, or a combination of the two for the benefit of wildlife and wildlife conservation.

The first refuge, the Pelican Island Refuge, was established in 1903 by President Theodore Roosevelt to protect pelicans and other birds with desirable plumes and feathers from hunting activities.[7] Since then the protection of migratory birds has remained a dominant purpose of the refuge system, with many refuges created specifically to act as an "inviolate sanctuary" for migratory birds.[8]



The National Wildlife Refuge System. Map compiled by the US Fish and Wildlife Service, Division of Realty, Washington, DC.

Refuges have also been created specifically for the critical purpose of protecting and providing habitat for threatened and endangered species listed as imperiled under the Endangered Species Act of 1973.[9] As a result, refuges play a critical role in promoting the survival and recovery of species nationwide.

National wildlife refuges provide habitat for more than 700 species of birds, 220 species of mammals, 250 reptile and amphibian species, and more than 1,000 species of fish. Those species include more than 280 plants and animals protected under the Endangered Species Act.

Historically the U.S. Fish and Wildlife Service, which manages the refuges, has allowed private farming on refuges in order to help prepare seed beds for native habitat, such as grasslands, and to provide food for migratory birds and other wildlife. Today, however, industrial farming and the heavy pesticide use that comes along with it are commonplace on refuge lands.

Nationwide every region of the refuge system except Alaska allows farming practices that often include the use of pesticides on commercial crops like corn, soy, wheat, rice and sorghum.

The oversight and management of national wildlife refuges is controlled principally by the 1997 National Wildlife Refuge Improvement Act, which directed the Service to administer all refuges as "a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources."[10] To support this goal, Congress directed the Service to "provide for the conservation of fish, wildlife and plants," and "ensure" that the biological integrity, species diversity, and environmental health of the refuge system are prioritized and preserved. [11]

THE REFUGE SYSTEM IS DIVIDED INTO EIGHT REGIONS:

- Region 1, the Pacific Region – Hawaii, Idaho, Oregon, Washington and the Pacific Island Territories;
- Region 2, the Southwest Region – Arizona, New Mexico, Oklahoma and Texas;
- Region 3, the Midwest Region – Minnesota, Iowa, Missouri, Illinois, Indiana, Ohio, Michigan and Wisconsin;
- Region 4, the Southeast Region – North Carolina, South Carolina, Tennessee, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, Puerto Rico and the U.S. Virgin Islands;
- Region 5, the Northeast Region – Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia and Virginia;
- Region 6, the Intermountain Region – Utah, Colorado, Kansas, Nebraska, South Dakota, North Dakota, Wyoming and Montana;
- Region 7 – Alaska;
- Region 8 – California and Nevada.

Refuges contain a diverse array of protected species and habitat types, including some that are rare and ecologically significant, especially low elevation habitats that have been largely destroyed elsewhere by intensifying agriculture and development. The central purposes of the refuge system include wildlife conservation and environmental health. "[F]ish and wildlife will not prosper without high-quality habitat, and without fish and wildlife, traditional uses of refuges cannot be sustained."[12] Continuing protection for species and their habitats is, therefore, crucial for preserving and maintaining the nation's treasured natural heritage.[13] By opening refuges to intensive farming that utilizes toxic pesticides the Service has failed to carry out its primary purpose of protecting wildlife.

PURPOSE OF AGRICULTURE IN NATIONAL WILDLIFE REFUGES

Under the Refuge Act, the three main questions considered in deciding which practices should be allowed on refuges are: (1) whether the proposed activity is consistent with the purpose of that refuge, (2) the mission of the refuge system, and (3) public safety.[14] To help answer those questions, the Act identifies "six primary public uses" to prioritize, assuming they are compatible with the refuge's principal conservation mandate; these wildlife-dependent recreational uses are wildlife observation and photography, fishing, hunting, environmental education and interpretation.[15]

Other uses, such as row-crop farming (often termed "cooperative farming"), are not considered to be a priority for refuges, but have been permitted when found to be "compatible."[16] The Act defines a "compatible use" as one that does not "materially interfere with or detract from the fulfillment of the mission of the System or the purposes

of the refuge."[17] In determining if cooperative farming is a compatible use, the Service must identify that the activity is not only consistent with the purpose of the refuge, the mission of the refuge system and public safety, but whether the use conflicts with other resource or management objectives, including species and biodiversity objectives. Pursuant to these constraints, farming activities "are [considered] permissible habitat management practices only when prescribed in plans to meet wildlife or habitat management objectives, and only when more natural methods, such as fire or grazing by native herbivores, cannot meet refuge goals and objectives."[18]

Whooping cranes courtesy Klaus Nigge, USFWS

Historically refuges allowed farming in order to help prepare seed beds for native habitat, such as grasslands, and to provide food for migratory birds and other wildlife. For example, during migration, migratory birds — including endangered species like the whooping crane — rely on refuges to provide a safe and nontoxic place for resting and foraging during their journey. Indeed, as many refuges were established in whole or in part to serve as sanctuaries for migratory birds,[19] the refuges themselves are often crucial to bird migration and health. This is especially true along the four main U.S. north-south waterfowl migration corridors, also known as the Atlantic, Mississippi, Central and Pacific Flyways.[20] Ostensibly, cooperative farming is supposed to enable that objective.

Today, however, extensive use of pesticides in industrial farming, including row-crop agriculture, threatens these sensitive habitats and the very purpose of the refuge system.

Individual national wildlife refuges can sometimes be organized into National Wildlife Refuge Complexes. A National Wildlife Refuge Complex is an administrative grouping of two or more refuges, wildlife-management areas, or other refuge-conservation areas primarily managed from one central office.[21] Refuges are generally grouped into these complexes because they are located in a similar ecological region, such as watershed or habitat type, and have related purpose and management needs.[22]

METHODOLOGY

The findings in this report were compiled from public records produced by the Service in response to a request by the Center for Biological Diversity under the Freedom of Information Act, 5 U.S.C. § 552. Subject to that request, the Service provided the Center with raw data on: (1) pesticides approved for agricultural use on refuges from 2014 to 2016; (2) the refuges on which those pesticides were used; (3) the number of acres on each refuge treated with approved pesticides for any given year; and (4) the amount of pesticides applied.

For each pesticide requested for use on a refuge, the Service — usually through its environmental contaminant or national wildlife refuge staff at the field, regional or national levels — undertakes a "pesticide use proposal" process.[23] Once a pesticide is approved, information on its uses, including use amounts, must be reported annually to the Service.[24]

Pesticide-use amounts are reported in terms of total pesticide product used, which is based on trade-name measurements rather than on the active chemical ingredients that make up the pesticide. In addition, application units for pesticide products are based on the form of the trade-name product (liquid or solid), and therefore were

provided in either pounds or gallons, depending on the product in question. For consistency and to harmonize the differing units for ease of review, all pesticide-use amounts in this report have been consistently converted to pounds using the pure water conversion rate of 8.3 pounds to every 1 gallon.

For example, in this report it is estimated that more than 490,000 pounds of pesticides were used on refuge lands in 2016. This estimate is a conversion from the original units of measurement of 56,905 gallons and 18,389 pounds of pesticides. In this case the existing gallon amount was multiplied by 8.3 and then added to the existing pound amount.

This conversion rate does not take into consideration the percentage of active ingredient in the trade-name pesticide. The rate also has not been adjusted based on the differences in molecular density of the pesticide products, both independently and in comparison to water. As a result the estimates provided in this report are not a precise accounting of active ingredients or an exact pounds-to-gallons conversion.

Finally, the Service provided the Center with use amounts per treated acre. Because multiple pesticides may be approved for use on one acre, the acre counts in this report do not necessarily represent unique acres but rather represent an aggregate total.

Spreadsheets containing the data used to calculate the figures for this report, as collected from the Center's FOIA requests, are available upon request.

FINDINGS ON AGRICULTURAL PESTICIDE USE IN NATIONAL WILDLIFE REFUGES

Overview

Based on the data provided by the Fish and Wildlife Service to the Center, more than 490,000 pounds[25] of pesticides were used to treat almost 271,000 acres of refuge lands in 2016 for agricultural purposes, a number that is relatively consistent with pesticide application rates for the previous two years. In 2015 approximately 467,000 pounds[26] were applied to 309,457 acres; in 2014 approximately 530,000 pounds[27] were applied to 279,424 acres.

The most significant uses of pesticides for agricultural purposes in the refuge system are in Region 4 (the Southeast region) and Region 8 (California and Nevada). In 2016, 147,396 acres in Region 4 were treated with a total of 172,413 pounds of 64 pesticides — alone and in combination — for agricultural purposes.

In Region 8 in that same year, approximately 39 pesticides — alone and in combination — were used to treat 59,900 acres with a total of 237,059 pounds of pesticides for agriculture. A majority of the pesticide application in Region 8 took place on the Klamath Basin National Wildlife Refuge Complex, and likely represents the application of multiple different pesticides to individual parcels of land.

The crops most frequently correlated with agricultural pesticide use on refuges are corn, soybean, wheat, rice and sorghum. Although these monocultures may provide the farmer with a profitable way to grow crops on an industrial scale, monoculture farming triggers infestations that trigger increased pesticide use.

In 2016 in just Region 3, for example, the following pesticides and pesticide combinations were approved for use just on corn: 2,4-D, clothianidin, dicamba, flumiclorac-pentyl ester, glufosinate-ammonium, glyphosate, imazethapyr, imidacloprid, mesotrione, nicosulfuron + rimsulfuron, saflufenacil + dimethenamid-P, salflufenacil, thiamethoxam and topramezone.

And, in that same region and year, the following pesticides were approved for use just on soy: 2,4-D, aminopyralid, clethodim, dicamba, flumiclorac-pentyl ester, flumioxazin + chlorimuron ethyl, glufosinate-ammonium, glyphosate, imazethapyr, imazapyr, lactofen, saflufenacil + dimethenamid-P, salflufenacil, sethoxydim and thiamethoxam.

The revelation that so many toxic pesticides have been approved for use on commercial monocultures by private farmers inside our national wildlife refuges raises important questions about the increasing risks the pesticides pose for the wildlife for which the refuges were created to protect.

Detailed Findings

A. *The Aerial Spraying of Pesticides for Agricultural Use*

The Service currently allows pesticides to be aerially applied for agricultural purposes on national wildlife refuge lands. This aerial spraying is an extremely concerning practice because the pesticide is applied at a greater height, and therefore can be more prone to movement from wind and other climatic pressures. As a result, pesticides that are aerially sprayed can lead to exposure of nontarget insects, plants and other species, including species the refuges are meant to protect.

Monarch butterfly on swamp milkweed in Michigan. Photo by Jim Hudgins/USFWS

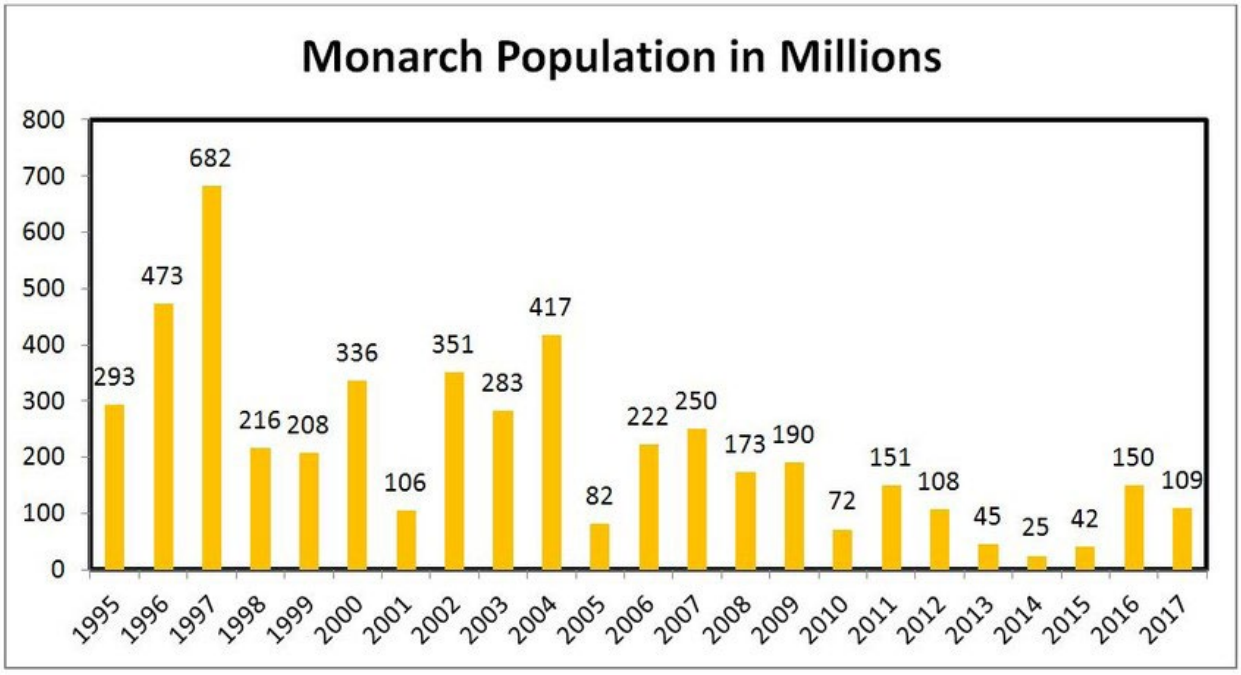
In 2016 pesticides were aerially sprayed in regions 2, 4, 6 and 8, with the most extensive aerial spraying taking place in regions 4 (Southeast) and 8 (Pacific). In that year a total of 107,342 acres of refuge lands were aerially treated for agricultural purposes with 127,020 pounds[28] of pesticides.

As further detailed below on a pesticide-specific basis, pesticides aerially sprayed on refuge lands in 2016 include, but are not limited to: aminopyralid, glyphosate, dicamba, 2,4-D, propanil, prosulfuron, paraquat dichloride, imazethapyr, halosulfuron-methyl and flupyradifurone. The approval of aerial spraying for drift-prone pesticides like dicamba and 2,4-D is particularly concerning.

B. *Dicamba*

The pesticide dicamba is considered to be toxic to fish, amphibians and crustaceans, and has been detected in water systems.[29] Further, as identified by the EPA, "[e]ven if only a small surface area of [a] plant is exposed to dicamba . . . there is a possibility that the plant may be severely damaged or die as a result."[30]

Yet the use of dicamba is not only approved for agricultural purposes in the refuge system, aerial spraying of the notoriously drift-prone pesticide is allowed.



Monarch butterfly population graph by Tierra Curry, Center for Biological Diversity.

In 2016 approximately 2,797 pounds[31] of pesticides containing dicamba were used to treat more than 8,366 refuge acres for agricultural purposes. Nearly half of the dicamba — approximately 1,328 pounds[32] — was applied using aerial-spraying practices across nearly 6,000 acres.

Dicamba has been called the "most controversial agrochemical product launched of the past decade," in large part because of its extreme predisposition to drift.[33] The pesticide's tendency to drift was spotlighted in 2017 when its widespread use on crops genetically altered to resist it resulted in close to 3,000 complaints by neighboring farmers who reported that their crops were damaged by the pesticide. Damage from drifting dicamba was reported to soybean crops, fruit trees, vegetables, vineyards and forests stretching from the Great Plains across the Midwest and Southeast.[34] Approximately 3.6 million acres of that reported damage was to soybean crops alone.[35]

As a result dicamba use was either banned or severely limited by several states, with the Arkansas becoming a literal battleground state around use of this pesticide.[36] The fact dicamba use is being dramatically restricted in many states because of the risks it poses should spur a re-evaluation of whether it's reasonable to ever allow aerial spraying of the unpredictable pesticide on wildlife refuges.

C. *Glyphosate*

Glyphosate is the active ingredient in Monsanto's flagship pesticide Roundup. It is the most widely used pesticide in the world, with 300 million pounds of it applied on U.S. farmland each year.[37] And in 2016 116,200 pounds[38] of pesticides containing glyphosate were used to treat approximately 55,487 agricultural acres in the refuge system.

Despite its popularity glyphosate is extremely controversial. In 2015 the World Health Organization's International Agency for Research on Cancer classified glyphosate — as well as the herbicides malathion and diazinon — as "probably carcinogenic to humans."[39] Following that finding, more than three dozen lawsuits have been filed against Monsanto by people claiming that Roundup was the cause of their non-Hodgkin's lymphoma.[40] Amidst considerable controversy, glyphosate is currently subject to registration review under the Federal Insecticide, Fungicide, and Rodenticide Act, and is under review by the pesticides program at the EPA.[41] Earlier in 2017 the California EPA became the first agency in the United States to list glyphosate as a known human carcinogen.[42]

Glyphosate and its metabolites are commonly found in air, rainfall and surface water samples near sites of use.[43] Glyphosate-resistant crops have also been shown to contain high levels of residual pesticide, which means that glyphosate and its residuals are likely being transferred into forage materials used by wildlife and birds on refuges.[44]

Compounding these concerns is the extensive use of glyphosate on agricultural lands, which may lead wildlife and other species to seek sanctuary in refuges from the pesticide's presence and persistence in their environment. Due to additionally excessive uses on refuge lands, however, those efforts may be in vain.

Use of glyphosate has been tied to widespread declines of milkweed, which is essential to monarch butterfly survival.[45] The threat this habitat loss poses to the continued existence of eastern monarch population cannot be overstated. The estimated overwintering population of monarchs in 2017 was just 109 million, down 27 percent from 2016 and down more than 80 percent from counts in the mid-1990s.[46]

Because glyphosate is often applied to crops that have been genetically engineered to resist it, overuse of the pesticide has spurred growth of glyphosate-resistant "superweeds" across millions of U.S. acres.[47] These glyphosate-resistant superweeds choke out native habitat and erode species biodiversity. To date at least 38 weed species across the world have evolved to develop a resistance to glyphosate.[48] Glyphosate-tolerant superweeds have caused land managers to turn to additional, and increasingly toxic, pesticides to combat their spread.

D. *2,4-D*

In 2016 more than 15,819 pounds[49] of pesticide containing the poisonous 2,4-D, alone and in combination, were

used to treat almost 12,000 refuge acres. Of those uses approximately 6,000 pounds[50] were applied using aerial-spraying practices across more than 5,300 acres.

The pesticide 2,4-D is used as a systemic herbicide against broadleaf plants.[51] It is also an ingredient in the biological weapon known as Agent Orange, an herbicide and chemical defoliant infamous for its use by the U.S. military during the Vietnam War.[52] Due to its extreme toxicity, any drift from 2,4-D application may damage neighboring crops and wild plants. Considered to be acutely toxic or highly acutely toxic to mammals, birds, fish, amphibians, crustaceans and reptiles, 2,4-D may also harm endangered species and their habitats.[53]

In 2011, for example, the National Marine Fisheries Service issued a biological opinion under the Endangered Species Act on the EPA's proposed registration of pesticide products containing 2,4-D and its effects on endangered and threatened Pacific salmonids.[54] The agency found that 2,4-D "will have a detrimental effect on . . . riparian vegetation," which "provides shade, bank stabilization, sediment, chemical and nutrient filtering, and provides a niche for the terrestrial invertebrates that are also salmon prey items." It concluded that the EPA's proposed registration of 2,4-D is likely to jeopardize the continued existence of endangered and threatened salmonids and is likely to destroy their critical habitat.[55] Also 2,4-D is a known endocrine disrupter, meaning it can have effects on the reproductive and immune systems that are capable of compromising populations of endangered species.[56]

In Region 4, in 2016, the Service authorized the use of more than 8,067 pounds[57] of pesticide containing 2,4-D, alone and in combination, on 6,658 acres of refuge land. Of those uses approximately 2,780 pounds[58] were approved for aerial spraying across a total area of 3,224 acres.

The Service identified the following federally protected species as likely to be directly affected by the aerial spraying of 2,4-D:

- Six mollusks including the endangered fat pocketbook, pink mucket, orangefoot pimpleback (also known as the pearlymussel), ring pink and rough pigtoe, as well as the threatened rabbitsfoot;
- One endangered fish, the pygmy madtom;
- Three mammals, the endangered Indiana bat, threatened northern long-eared bat and endangered red wolf;
- Two birds, the threatened red knot and endangered red-cockaded woodpecker;
- One plant, the threatened sensitive joint-vetch.

E. *Paraquat Dichloride*

Paraquat dichloride (paraquat) is an extremely lethal pesticide linked to Parkinson's disease.[59] In 2008 an eight-year-old boy died after drinking from a Dr. Pepper bottle that had been used to store paraquat. In 2010 a 44-year-old man mistakenly drank paraquat, thinking it was fruit juice. He experienced difficulty breathing, vomited blood and died after 20 days of hospitalization."[60] Paraquat is also toxic to mammals, fish, amphibians and mollusks.[61] These toxicity rankings are based on data from the EPA, which has also estimated that environmental concentrations of the pesticide are likely to exceed the "levels of concern" for endangered species, and/or may cause indirect effects on endangered species by altering habitat or food sources.[62] Use of paraquat has been banned in 32 countries, including the European Union since 2007, largely due to human health concerns.[63] Further, because paraquat is prone to drift, its effects may not be localized to the application site, but may spread across a larger geographic area.[64]

Despite paraquat's well-documented risks, it continues to be used in Region 4, the Southeast region of the refuge

system. In 2016 paraquat was used to treat soybean and corn crops in the West Tennessee Refuge Complex, Pocosin Lakes National Wildlife Refuge and Theodore Roosevelt National Wildlife Refuge Complex (a refuge named for the presidential founder of the refuge system). And it was approved for aerial application in both the Pocosin Lakes and Theodore Roosevelt refuges.

In total in 2016, approximately 6,800 pounds[65] of pesticides containing paraquat were used to treat 3,176 acres in Region 4; of that, more than 5,000 pounds[66] were aerially applied to 2,313 acres. Federally protected species likely to be harmed by these practices include the endangered fat pocketbook mollusk, threatened northern long-eared bat, endangered pallid sturgeon, endangered pondberry plant, endangered red wolf and threatened Louisiana black bear.

F. *Neonicotinoids*

Neonicotinoids are the class of pesticides derived from nicotine that affect the central nervous system of insects, resulting in paralysis and death. They include the pesticides imidacloprid, acetamiprid, clothianidin, dinotefuran, nithiazine, thiacloprid and thiamethoxam. Neonicotinoids are most often associated with their negative effects on pollinator health[67] Because of this, in 2014 the Service issued a policy to discontinue the use of neonicotinoids in agricultural practices in the refuge system.[68] The policy went into effect in January 2016.

Data provided to the Center confirm that all regions discontinued the use of neonicotinoids in refuges by 2016 except for Region 8. Records indicate that imidacloprid was still used in Region 8 on the Klamath Basin National Wildlife Refuge Complex to treat potato crops. Specifically, in 2016, 498 pounds[69] of pesticide containing the neonicotinoid imidacloprid were applied to nearly 1,175 acres of potatoes on that refuge.

However, all neonicotinoid use has now been discontinued in the refuge system, according to federal records. Not only does this represent an essential step for saving imperiled pollinators and other species, but it demonstrates that the refuge system can successfully transition away from pesticide use and continue to successfully meet the wildlife management and conservation objectives of individual refuges and the system as a whole.

CASE STUDY: WHEELER NATIONAL WILDLIFE REFUGE COMPLEX

In Alabama, where industrial farming dominates the landscape, the refuge system affords critical protection for endangered species and foraging grounds for pollinators. Eleven refuges are located in whole or in part in Alabama, more than half of which are managed as a part of the Wheeler National Wildlife Refuge Management Complex (Wheeler Complex).[70]

The Wheeler Complex is composed of: Wheeler NWR, Key Cave NWR, Fern Cave NWR, Sauta Cave NWR, Watercress Darter NWR, Cahaba River NWR and Mountain Longleaf NWR. Federally protected species that depend on the natural resources on the refuges in this complex include the endangered Alabama cavefish, endangered gray gat, endangered Indiana bat, threatened American Hart's-tongue fern, endangered watercress darter, endangered red-cockaded woodpecker, threatened finelined pocketbook clam, threatened triangular kidneyshell clam, endangered upland combshell clam, endangered Cahaba shiner, threatened goldline darter, endangered cylindrical lioplax snail and threatened round rocksnail.

Four refuges in the complex — Key Cave, Fern Cave, Sauta Cave and Watercress Darter — were established specifically for the preservation of endangered species.[71] Yet pesticides are commonly used on cooperative farms on this complex.

The Key Cave National Wildlife Reserve, for example, is the only known location of the Alabama cavefish (a small, blind, colorless fish that inhabits the underground pools in Key Cave) and is also a priority-one maternity cave for the endangered gray bat.[72] In addition, Key Cave provides habitat for a variety of migratory and resident wildlife species, including the grasshopper sparrow, field sparrow, dickcissel, northern harrier, short-eared owl and northern bobwhite.[73]

Northern bobwhite by panza.rayada, CC-BY-SA

In total at least 166 bird species have been sighted on the refuge.[74] Other common wildlife species include cottontail rabbits, coyotes, white-tailed deer, gray squirrels, eastern meadowlarks, mourning doves, horned larks and eastern bluebirds.[75]

In 2016, however, almost 490 pounds[76] of pesticides were used to treat 1,090 acres of crops on the refuge. Those pesticides — of which more than 340 pounds[77] were pesticides containing glyphosate — were largely used on corn and soy crops. For comparison, approximately 875 pounds[78] of pesticides were used to treat 844 acres on Key Cave in 2015, 610 pounds[79] of which were pesticides containing glyphosate. And almost 400 pounds[80] of pesticides were used to treat 701 acres on Key Cave in 2014, more than 150 pounds of which were pesticides containing 2,4-D and 150 pounds of which were pesticides containing dicamba.

This egregious use of pesticides is made all the more tragic by Key Cave's history. Prior to being established as a refuge in 1997, Key Cave was owned by the Monsanto Company, which sold the tract to the Conservation Fund in 1992.[81] Historically the lands were used for growing cotton and suffered practices that led to "severe soil erosion problems both on and off refuge lands," which caused the release of contaminant and sedimentation into the water system[82] As a result, "[w]ater quality monitoring by the U.S. Geological Survey has identified a variety of agricultural pesticides in surface waters near the Wheeler National Wildlife Refuge[, which shares the refuge complex with Key Cave]. In addition, water quality monitoring by the Service has identified detectable levels of atrazine in surface waters flowing onto Wheeler NWR."[83] These are issues of particular concern on the Key Cave NWR because the Key Cave lies on the northern shore of Pickwick Lake in a limestone karst area that contains numerous sinkholes and several underground cave systems. This makes the area's sinkholes an integral component of groundwater recharge for the cave — a cave that, as mentioned above, is the only known home of the endangered endemic Alabama cavefish.

The threats posed by the pesticide use extend to the watershed level, the Tennessee River Valley is made up of several aquatic ecosystems that have been greatly deteriorated by human activities. Impacts to aquatic species and their habitat include: impoundment of free-flowing streams and rivers; habitat degradation from erosion and sedimentation; misuse of fertilizers, pesticides and herbicides; toxic chemical discharges

Blackwater National Wildlife Refuge Chesapeake Marshlands National Wildlife refuge complex courtesy Ray Paterra, USFWS

from both point and nonpoint sources; and competition from exotic and/or invasive aquatic species. All of these events have led to degradation of aquatic ecosystems within the Tennessee River Valley and each refuge within the Wheeler Complex.

One of the most damaging events to aquatic ecosystems in the Tennessee River Valley has been the previous use of organochlorine pesticides (e.g., DDT, toxaphene, dieldrine and lindane).These persistent chemicals were commonly used in farming operations (especially cotton) prior to being banned in the 1970s. Throughout northern Alabama, they may remain in the soil substrate for long periods of time and have been linked to an assortment of contamination issues and continue to detrimentally impact fish and other aquatic-dependent resources, such as fish-eating birds, wood ducks and raccoons.[84]

In addition to concerns related to impacts to Alabama cavefish populations from continuing pesticide use on the Key Cave National Wildlife Refuge, the gray bat, which is a federally protected endangered species found on the Key Cave refuge, "has become of particular concern. Its population decline is believed to be due primarily to human disturbances such as: vandalism, excessive pesticide use, overall insect prey decline due to pollution, and cave commercialization."[85]

Additionally, the northern bobwhite, "[o]ne of the grassland-dependent bird species of concern on the Wheeler and Key Cave refuges," has been facing population declines with the "North American Breeding Bird Survey data indicat[ing] that a rangewide decline of 3.0 percent annually has occurred between the years of 1966 and 2003."[86] According to the Service, "[w]hile many factors have contributed to this decline, including predators, pathogens, and pesticides, deteriorating habitat quality is the primary cause of decline."[87]

These are just a few of the many egregious examples of pesticide abuse for row-crop, commercial agriculture in the refuge system.

Cropland at Sonny Bono Salton Sea National Wildlife Refuge, Calif. Photo by Daniel Mayer, CC-BY-SA

RECOMMENDATIONS

To protect species diversity and the overall health of our refuges, the Service must ban the use of dangerous pesticides for commercial agricultural purposes.

At a minimum the Service should emphasize land-use practices that are not reliant upon pesticide use and prioritize species and ecosystem health in the refuge system by eliminating all preventable and concerning uses of pesticides for commercial agricultural purpose, including:

- Aerial spraying of pesticides;
- Use of pesticides in ecologically sensitive areas;
- Use of pesticides in areas already impaired by historic chemical pollution;
- Use of pesticides in areas inhabited or relied upon by species sensitive to pesticide exposure, including birds, bats, beneficial insects and aquatic species;
- Use of extremely toxic, drift prone pesticides like 2,4-D, dicamba and paraquat;

If the Service does not ban the continued use of pesticides for agricultural purposes, it should implement a comprehensive, systemwide monitoring program to consistently identify and immediately discontinue any uses that cause harm to species or contamination of refuge lands, including surface waters.

For areas where pesticide contamination has occurred, the Service should require cleanup and abatement of any activity determined to harm any refuge species or ecosystem, including by contributing to pollution of surface waters.

ENDNOTES

1 "A National Wildlife Refuge Complex is an administrative grouping of two or more refuges, wildlife management areas or other refuge conservation areas that are primarily managed from a central office location. Refuges are grouped into a complex structure because they occur in a similar ecological region, such as a watershed or specific habitat type, and have a related purpose and management needs." FWS, Tennessee National Wildlife Refuge Complex, About the Complex, https://www.fws.gov/refuge/Tennessee/About_the_Complex.html.
2 The Klamath Basin National Wildlife Refuge Complex includes Bear Valley National Wildlife Refuge, Upper Klamath National Wildlife Refuge, Klamath Marsh National Wildlife Refuge, Tule Lake National Wildlife Refuge, Lower Klamath National Wildlife Refuge, and Clear Lake National Wildlife Refuge. FWS, About the Complex, https://www.fws.gov/refuge/Tule_Lake/About_the_Complex.html.
3 The Central Arkansas Refuges Complex includes Wapanocca National Wildlife Refuge, Cache River National Wildlife Refuge, Bald Knob National Wildlife Refuge, Big Lake National Wildlife Refuge, Logan Cave National Wildlife Refuge, and Holla Bend National Wildlife Refuge. FWS, About the Complex, https://www.fws.gov/refuge/wapanocca/About_the_Complex/.
4 The West Tennessee Refuge Complex includes Reelfoot National Wildlife Refuge, Chickasaw National Wildlife Refuge, Lower Hatchie National Wildlife Refuge, Hatchie National Wildlife Refuge and Lake Isom National Wildlife Refuge. FWS, West Tennessee Refuge Complex, https://www.fws.gov/westtnrefuges/.
5 The Tennessee National Wildlife Refuge Complex includes the Tennessee National Wildlife Refuge and Cross Creeks National Wildlife Refuge. FWS, About the Complex, https://www.fws.gov/refuge/Tennessee/About_the_Complex.html.
6 The Chesapeake Marshlands National Wildlife Refuge Complex includes the Blackwater National Wildlife Refuge, Eastern Neck National Wildlife Refuge, Martin National Wildlife Refuge, and Susquehanna National Wildlife Refuge. FWS, About the Complex, https://www.fws.gov/refuge/Blackwater/About_the_Complex.html.
7 Exec. Order of March 14, 1903; National Wildlife Refuge System Centennial Act of 2000, Pub. L. 106-408, 114 Stat. 1762.
8 16 U.S.C. § 715d.
9 16 U.S.C. § 1534.
10 16 U.S.C. § 668dd(a)(2) ("The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.").
11 16 U.S.C. § 668dd(a)(4)(B).
12 Executive Order 12996, 61 Fed. Reg. 13647 (Mar. 28, 1996).
13 Fish and Wildlife Service (FWS), Biological Integrity, Diversity, and Environmental Health Policy, 601 FW 3, 3.15(B), available at https://www.fws.gov/policy/601fw3.pdf. (The Refuge Act "clearly establishes that wildlife conservation is the singular National Wildlife Refuge System mission.").
14 16 U.S.C § 668dd(a)(3)(B); see also § 668dd(d)(1)(A); id. § 668ee(2).
15 Id.
16 Id. § 668dd(a)(3)(C).
17 Id. § 668ee(1); see also 50 C.F.R. § 25.21.
18 FWS, Biological Integrity, Diversity, and Environmental Health Policy, 601 FW 3, 3.15(B), available at https://www.fws.gov/policy/601fw3.pdf.
19 16 U.S.C. § 715d.
20 GAO, National Wildlife Refuges: Continuing Problems with Incompatible Uses Call for Bold Action, Report No. GAO/RCED-89-196 (1989), available at http://www.gao.gov/assets/150/148073.pdf
21 FWS, Tennessee National Wildlife Refuge Complex, About the Complex, https://www.fws.gov/refuge/Tennessee/About_the_Complex.html.
22 Id.
23 Relevant authorities for this PUP process include Department of Interior, Pesticide Use Policy (517 DM 1); Service Integrated Pest Management Policy (569 FW 1); and the Federal Insecticide, Fungicide, Rodenticide Act.
24 See id.
25 This number was converted from 56,905 gallons and 18,389 pounds.
26 This number was converted from 53,502 gallons and 23,156 pounds.
27 This number was converted from 56,905 gallons and 18,389 pounds.
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and Dicamba Sodium, Potassium, Diglycoamine, Dimethylamine and Isopropylamine Salts 3
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http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2005-0479-0008.
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76 This number was converted from 58 gallons and 7 pounds.
77 This number was converted from 41 gallons.
78 This number was converted from 105 gallons and 2.85 pounds.
79 This number was converted from 73.7 gallons.
80 This number was converted from 43.76 gallons and 32.13 pounds.
81 Id. at 16.
82 Id. at 83.
83 Id.
84 Id. at 28.
85 Id.
86 Id.
87 Id. at 77.