SILENT SPRING

REVISITED

Pesticide Use and Endangered Species

Center for Biological Diversity

Silent Spring Revisted:
Pesticide Use and Endangered Species

A Center for Biological Diversity Report

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The Center for Biological Diversity protects endangered species and wild places through science, policy, education, and environmental law.

These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and homes - nonselective chemicals that have the power to kill every insect, the "good" and the "bad," to still the song of birds and the leaping of fish in the streams, to coat the leaves with a deadly film, and to linger on in soil - all this though the intended target may be only a few weeds or insects. Can anyone believe it is possible to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life? They should not be called "insecticides," but "biocides."

~Rachel Carson, *Silent Spring*, 1962 ~

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EXECUTIVE SUMMARY

More than two billion pounds of pesticides are sold each year in the United States for agricultural, commercial, and home uses. At present, the Environmental Protection Agency (EPA) has registered more than 18,000 pesticides.The public assumes pesticide products are safe because they are registered for use by the EPA, but their faith is misplaced.

The most recent example of the EPA's unfortunate obeisance to the industries it was intended to regulate was revealed in November 2003, when it renewed its registration of the chemical atrazine. Atrazine, an herbicide used heavily throughout the United States, is so dangerous to humans and wildlife that it was recently banned by the European Union.

More than two billion pounds of pesticides are sold each year in the United States for agricultural, commercial, and home uses.

As this report documents, the EPA's regulatory oversight of the pesticide industry is abysmal. When confronted with credible studies on the adverse impacts of pesticides, the EPA has consistently responded by attempting to diminish the findings in any way it can, even though it has admitted that "most pesticides pose some degree of risk because they are designed to have a negative effect on living organisms."[1]

While the Environmental Protection Agency is entrusted to protect public health and the environment it has consistently attempted to ignore mounting evidence demonstrating that even low doses of pesticides in wildlife and humans can have drastic consequences. By ignoring sound science, disregarding U.S. Fish and Wildlife Service requests to alter pesticide registrations because of adverse impacts to wildlife, and rushing to get pesticides on the market, the EPA's Office of Pesticide Programs has proven it is not an independent entity.

Yet despite numerous studies linking atrazine to significant human and wildlife health concerns (including endocrine disruption), the EPA announced it would impose no new restrictions on its use. Rather, the EPA entered into a private deal with the manufacturers of atrazine, including the giant chemical corporation Syngenta, in which the corporations will monitor a mere 40 of the 1,172 watersheds the EPA has recognized as being "at risk" of contamination. This is just one example of how the EPA is placing humans and wildlife at risk to serve the agrochemical industry.

What's more, under the administration of George W. Bush, the EPA is attempting to further subvert the public interest by changing the rules governing pesticide evaluations. Although the EPA by law is required to consult with the U.S. Fish and Wildlife Service on pesticide registration, it has failed to complete a single consultation in the last ten years despite repeated formal requests from the wildlife agency and the unambiguous requirements of the Endangered Species Act.

The EPA has abrogated its responsibilities under federal laws intended to protect human health and imperiled wildlife, including the Federal Insecticide, Fungicide, and Rodenticide Act, the Food Quality Protection Act, and the Endangered Species Act. As a result, wildlife and humans remain at risk.

Now, the EPA is introducing regulations that would undercut the Endangered Species Act and allow the agrochemical industry to control research on the environmental impacts of its products. The proposed regulations leave sole responsibility for determining whether pesticides threaten endangered species in the hands of the EPA, despite its dismal track record. Further, the rule would cut out the federal agencies that have expertise about endangered species from the assessment process.

This report exposes the EPA's failure to protect people and wildlife from exposure to harmful pesticides and highlights the agency's on-going refusal to reform pesticide use in accordance with scientific findings. It reveals what the EPA ignores: Pesticides pollute significant areas of our air and water, threaten endangered species, and continuously expose farm workers, women of reproductive age and children to harmful levels of chemicals.

The EPA's policies of dereliction can be reversed through diligent citizen action. By insisting that federal agencies adhere to the laws protecting rare animals and plants, members of the public can curtail and reduce their exposure to known carcinogens and other substances that have a deleterious effect on human health. By ensuring that our government upholds its promise to protect the natural world, we can better protect ourselves. Humans are not immune from the ravishments we unleash on nature. Our fate is ultimately entwined with that of natural ecosystems.

Pesticides pollute significant areas of our air and water, threaten endangered species, and continuously expose farm workers, women of reproductive age and children to harmful levels of chemicals.

Callippe silverspot butterfly

Found at only two sites, Callippe silverspot larvae is often killed by pesticides found in runoff (see p. 26).

Photo by Dr. Richard Arnold, Entomological Consulting Services

BACKGROUND ON PESTICIDE USE

Widespread use of synthetic pesticides began after World War II when federal and local governments sponsored large-scale spraying programs using organochlorines, such as the now-infamous DDT. Today, more than two billion pounds of pesticides are used each year in the United States to control weeds, insects and other organisms.[2] Although many of the organochlorines have been phased out, they have been replaced with less persistent yet still dangerous chemicals such as organophosphates, carbamates and triazines.

Agriculture now accounts for 70% to 80% of total pesticide use[3] with few mandatory measures in place to protect human health and the environment. The bulk of the agricultural pesticides are herbicides, which comprise 60% of agricultural use by weight.

Home and commercial uses also contribute significant amounts of pesticides to our environment. The EPA estimates that 85% of all households have at least one pesticide in storage.[4] Of those homes, an estimated 76% of residents self-treat their abodes for pest and weed control. 10% of single-family households use a commercial lawn service, while an additional 20% applied lawn chemicals themselves.[5] Insecticides, which are generally more toxic to aquatic life, are more commonly used in urban areas. Yet the EPA is doing little to assess the impacts of residential and commercial pesticide use and is only taking marginal steps to mitigate the use of agricultural and commercial uses to protect wildlife. It is little wonder that the U.S. Geological Survey (USGS) found that "[a]lmost every sample of water and fish from streams and major rivers in all land use settings contained at least one of the pesticides that we measured. This means that, throughout the nation, almost every time and place that you observe a stream or river in a populated area you are looking at water that contains pesticides, inhabited by fish that contain pesticides."[6]

It is imperative that we better understand the threats pesticides pose to wildlife and humans. Potential impacts can best be assessed by analyzing two key attributes of any environmental contaminant: its biological effects (or toxicity) and the degree to which it is contained or to which it spreads. We will take up the latter attribute first, since once a pesticide is introduced into the environment, its persistence and movement ultimately determine the degree of harm it will cause "non-target" plants and animals.

Line drawing courtesy of the Canadian Wildlife Service

Contaminated Waterways

Water is one of the primary paths by which pesticides are transported away from their application areas - often through agricultural and urban runoff.[7] Movement of pesticides via runoff can occur whether pesticides are dissolved in the water or bound to suspended sediments in the water. Polluted runoff can pose both acute and chronic problems to plants and wildlife.

The USGS, after engaging in a series of water quality studies, released several reports that documented the astounding ubiquity of pesticides in our waterways.[8] Streams and ground water in basins with significant agricultural or urban development, or with a mix of these land uses, almost invariably were found to contain mixtures of nutrients and pesticides. At least one pesticide was found in almost every water and fish sample collected by the USGS. Moreover, individual pesticides seldom were found alone; almost every sample from streams contained two or more pesticides.

Yet the EPA continues to assess the risk of each pesticide individually, and fails to consider cumulative and synergistic effects. Not surprisingly, the USGS noted a direct correlation between the amounts and types of pesticides used and their frequency in nearby surface waters. Pesticides were found not simply in minute quantities, but at concentrations established as levels of concern, insofar as the EPA or other regulatory bodies have set such levels. Although these studies demonstrate the prevalence of pesticides in our waters, they represent a mere snapshot of pesticides in our environment, since the USGS did not assess pesticide concentrations in our waters through daily monitoring over the entire season or seasons the pesticides were used. With a limited sampling size, the USGS studies most likely do not reflect the highest concentrations, and fail to measure the duration pesticides persist in our waters.

Black skimmer killed by pesticides

Photo by Ted Below

Contaminated Soils, Contaminated Biota

Pesticide presence in the sediment of stream bottoms also indicates that the pesticide is or was present in the water of that stream.[9] Sediment serves as habitat for benthic biota at the bottom of the food chain, such as clams and insects, many of which become food for fish. Sediment can act as a reservoir for contaminants in the stream. Pesticides can move into and out of stream bottom sediments through multiple processes: settling of contaminated suspended sediments; re-suspension and net export of sediments in the water column; adsorption onto and release from mineral or organic sediments depending on stream flow, acidity and temperature, as well as from interactions with stream-bottom organisms; ingestion or surface absorption by organisms; or elimination of wastes and release from decaying contaminated organisms.[10] Pesticides can persist and accumulate in sediment and aquatic biota through such processes even when pesticide concentrations in water are too low to be detected using conventional sampling and analytical methods.

California red-legged frogs

Concentrations in aquatic biota may be a better indicator of contamination than direct assay of water or sediments. The USGS reports that 44% (41 of 93) of the pesticides they searched for in their national sediment survey were detected in sediment, whereas 64% (68 of 106) were detected in an aquatic biota study.[11]

Herbicides in current use, such as benfluralin, besulide, dacthal, ethafluralin, 2,4-DB, dicamba, diuron, triallate, and trifluralin, as well as the insecticides chlorpyrifos, dicofol, endosulfan, esfenvalerate, fenthion, fenvelaerate, lindane, methoxychlor, permethrin, phorate, and propargite, were all detected in stream sediment or biota, raising questions about their long-term impacts to wildlife and human health.

Photo by William Flaxington

PESTICIDE DRIFT

Runoff is not the only mechanism by which pesticides travel inadvertently. Pesticide drift is any airborne movement of pesticides away from the target site. Drift can result from aerial application, as well as from wind movement over soils containing pesticides. Airborne vectors of pesticides include droplets, dusts, volatilized vapor-phase pesticides, and pesticide-contaminated soil particles. Aerial pesticide applications typically result in "considerable" off-site drift, according to the National Research Council .[12] The quantity of pesticide drift can vary from 5% under optimal low-wind conditions to as high as 60%.[13] The Congressional Office of Technology Assessment estimates that about 40% of an aerial insecticide application leaves the target area and that less than 1% actually reaches the intended pest.[14] The typical range for drift is 100 to 1,600 meters.[15] However, longer ranges have been documented. For example, drift from orchard applications in Vermont exceeded two miles.[16] Application on wheat fields in Colorado drifted between five and ten miles.[17] Applications in California drifted four miles from an oat field; while drift has been noted ten to 50 miles from applications in central Washington.[18]

Impacts to wildlife from pesticide drift have been documented. Studies have implicated pesticide drift from the Central Valley of California in disproportional declines of several native frog species in the Sierra Nevada. Even frogs collected from high in the Sierra Nevada in areas with no direct pesticide use contain pesticides that appear to be compromising their immune systems.[19] The victims include the California red-legged frog (*Rana aurora draytonii*), foothill yellow-legged frog (*Rana boylii*), mountain yellow-legged frog (*Rana muscosa*), and Yosemite toad (*Bufo canorus*). Studies have found a close correlation between the declining populations of amphibians and exposure to agricultural pesticides.

The USGS found concentrations of diazinon, endosulfan, and chlorpyrifos at toxic levels in over half the frogs tested in one study – raising significant concerns about the transfer of pesticides and impacts of their use on non-target organisms living far away from the point of application.[20]

Recently, Californians for Pesticide Reform (CPR) released *Secondhand Pesticides: Airborne Pesticide Drift in California*,[21] documenting the adverse impacts of pesticide drift on humans and wildlife. The analysis found pesticides far from

Helicopter spraying pesticides

their application sites at concentrations significantly exceeding acute and chronic exposure levels deemed "safe" by the EPA. The study also noted that the "acceptable" levels of exposure are unlikely to adequately protect humans because the levels are determined by exposure to only one pesticide in isolation from other toxicants. Failure to incorporate cumulative and synergistic effects means the "acceptable" levels are under-protective. The EPA requirements also fail to adequately evaluate sub-lethal effects, such as endocrine and developmental alterations.

Photo courtesy of USFWS

The CPR study reported that pesticide drift causes acute human poisonings every year, with children most at risk. However, the study noted that exposures to levels below those that result in poisoning symptoms are far more common. This long-term low-level exposure can lead to chronic illness such as various types of cancer, asthma, respiratory ailments, neurological disorders, birth defects, miscarriages and sterility. Exposure early in life can result in impaired growth and development, cancers and lifelong disabilities. For example, diazinon and chlorpyrifos, commonly used pesticides that can be found throughout the waters of the United States, reduce development of neural connections and have been documented as endocrine disruptors. An endocrine disruptor is a synthetic chemical that when absorbed into the body either mimics or blocks hormones and disrupts the body's normal functions. The pesticide molinate, used almost exclusively for rice and heavily used in California, is linked to testicular damage and developmental neurotoxicity. The CPR study documented molinate many times above levels considered hazardous to children for short-term exposures up to 75 feet from the application area. Molinate levels were many times above levels considered hazardous to children in towns 25 miles from the area of highest molinate use.

This study's findings are confirmed by the EPA. The EPA notes that pesticide spray drift has been and continues to be of concern.[22] The Agency receives thousands of reported complaints of off-target spray drift each year.[23] Although the EPA states that its policy is to prevent drift from the target site, it acknowledges that some degree of drift of spray particles will occur from nearly all applications.

> The EPA's voluntary standards to control spray drift place humans and wildlife at risk.

To prevent spray drift, the EPA relies on applicators following pesticide labels. However, the EPA itself acknowledges that current labels are inadequate in preventing spray drift.[24] For example, in a recently released Interim Re-registration Eligibility Decision for the highly toxic pesticide atrazine, the EPA simply states the following under "Spray Drift Management": "The Agency is currently working with stakeholders to develop appropriate generic labels to address spray drift risk. Once this process is completed atrazine labels will need to be revised to include this additional language."[25]

Although the EPA published draft guidance for label statements on August 22, 2001, it has yet to finalize the label guidance for spray and dust drift, and the agency notes "registrants (and applicants) may choose to use the statements proposed in the draft PR notice" [underlining added].[26]

The EPA's voluntary standards to control spray drift place humans and wildlife at risk. The CPR study notes that the current EPA pesticide label language is inadequate to control spray drift. Until the EPA aggressively addresses spray drift, it will continue to abrogate its duties under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to protect humans and the environment from unreasonable adverse effects. Furthermore, the EPA's failure to control spray drift jeopardizes endangered species, in violation of the Endangered Species Act (ESA).

PESTICIDES and AQUATIC LIFE CRITERIA

The USGS has noted that the health of aquatic life may be more at risk than human health from pesticide contamination in streams.[27] It has been known for several decades that aquatic life may concentrate or "bio-accumulate" certain pesticides. In addition, aquatic organisms may be so sensitive to the presence of pesticides that they serve as more refined indicators of pesticide contamination than chemical assays.

"Aquatic life criteria" (ALC) have been developed by the EPA and others to determine the risk to aquatic life from water contamination. ALC are developed for specific pollutants to provide guidance to states and tribes on adopting water quality standards, and are the basis for regulating discharges or releases of pollutants.

USGS sampling found that aquatic life criteria values were frequently exceeded in U.S. streams.[28] For example, one or more ALC was exceeded in 67% of the 58 sampling sites.[29] Almost every urban stream sampled had concentrations of insecticides that exceeded at least one guideline, and most had concentrations that exceeded a guideline in 10% to 40% of samples collected throughout the year.[30] For herbicides, the study found a seasonal pulse of elevated concentrations of pesticides following applications.[31] Insecticides were found to persist above ALC for longer periods of time in both urban and agricultural sites.[32]

Further concern for aquatic organisms is raised by the fact that ALC have been established for only a few pesticides. In the USGS study of our nation's waters, the USGS refers to ALC established by three different bodies. The ALC established by the EPA were used for six of the target compounds,[33] Canadian values were used for eleven compounds with no EPA-established values,[34] and the ALC established by the Great Lakes Water-Quality Objective were used for diazinon.[35] No ALC have been established for the remaining 28 compounds covered by the USGS study.[36] Of the target herbicides in the USGS study, only 33% had an established ALC, and for the target insecticides, only 47% had an established ALC. Of the pesticides that have an ALC, the USGS study found that concentrations of one or more compounds exceeded an ALC value in at least one sample from 68% of the agricultural sites, 91% of the urban sites, and 40% of the integrator sites (mixed land use sites). At four of these sites, six to eight compounds were detected at concentrations greater than their ALC.

Fish kill due to pesticide spray

Photo courtesy of USFWS

The herbicides triallate, trifluralin, metolachlor, atrazine, and cyanazine were all found in levels exceeding their ALC. The ALC for atrazine and cyanazine were exceeded more frequently than the other target compounds. For the nine target insecticides that have an established ALC (carbofuran, dieldrin, a-HCH, lindane, parathion, azinphos-methyl, chlorpyrifos, diazinon, and malathion), the study found that all of their criteria values were exceeded.

Dunlin, a migratory shorebird, killed by exposure to pesticides

Despite the fact that aquatic life criteria are more commonly observed in the breach and, even more common than that, in their complete absence in the case of most pesticides, ALC most likely underestimate the impact to aquatic organisms. As such, the assessment of various pesticides' impacts must regard occurrences of excess ALC levels as an almost certain indication of severe deleterious effects.

Several factors contribute to uncertainty regarding the potential effects of the presence of pesticides in our waters, and likely indicate the impacts of pesticides are much greater than the EPA's ALC would lead one to believe: (1) ALC do not address chronic exposure to pesticide amalgamations or mixtures, failing to take into account possible additive or synergistic effects of more than one pesticide or combinations of pesticides, much less pesticide transformation products; (2) ALC do not address the prevalence or toxicity of pesticide breakdown products; (3) ALC do not address the strong seasonality of concentration patterns (resulting in repeated pulses of high concentrations); (4) ALC do not evaluate some types of biological effects (e.g. endocrine disruption); and, as noted, (5) the EPA has established few ALC for the thousands of registered pesticides. It can be seen from these factors, acknowledged by the USGS but ignored by the EPA, that sole reliance on whether an EPA-established ALC is exceeded as an indicator of whether species may or may not be adversely affected would be an exceedingly thin blanket of protection.

The USGS also reported that several pesticide degradation products were commonly detected. These substances were found at higher levels and can persist much longer than the parent compounds.[37] For example, total herbicide breakdown products were frequently found at more than ten times the concentration of the parent compounds over a two-year period.[38] Failure to incorporate this pertinent fact into an analysis of pesticide impacts on aquatic biota would erroneously raise the acceptable concentrations of pesticides for aquatic biota in our surface waters.

Photo by Ted Below

The mere fact that ALC do not address the cumulative effects of the presence of multiple pesticides is enough to indicate that any determination of no adverse effects on aquatic biota, based solely on ALC exceedences, would be inadequate. The USGS reported that the presence of multiple pesticides with concentrations greater than their ALC was "widespread," occurring at 29 sites. On average, about 20 of the target compounds were detected at each site regardless of land-use setting and basin size, and an average of six to seven of the target compounds were detected in each individual sample. The USGS also noted that pesticides almost always occur as mixtures.[39]

For example, in the San Joaquin River and the Willamette River basins, concentrations of two or more insecticides often exceeded criteria values in the same sample or during the same period. In Oregon, concentrations of several insecticides, including azinphos-methyl, carbofuran, chlorpyrifos, diazinon, and malathion, as well as the herbicide atrazine, were higher than or near criteria values at various times, often in the same samples. The presence of multiple pesticides can be found in urban streams as well. About 80% of samples from urban and mixed land use streams contained more than four pesticides. About 15% of all stream samples contained more than ten pesticides. With all the recorded ALC exceedences, it is clear that organophosphates, carbamates, and triazines pose significant threats to aquatic species.

With such a pervasive presence of multiple pesticides, any determination of effects made on a single pesticide basis will clearly fall short of recognizing the real impact the pesticide is having, in combination with other pesticides, on aquatic listed species. The EPA does not test pesticides in combination with other chemicals, although their synergistic effects (the simultaneous action of separate pesticides which, together, have greater total effect than the sum of their individual effects) may be amplified by as much as 1,000 times.

San Joaquin River National Wildlife Refuge, California

Photo courtesy of USFWS

For example, in April 1996 researchers at the Duke University Medical Center and the Texas Southwestern Medical School studying Gulf War Syndrome in veterans reported in the Journal of Toxicology and Environmental Health that the simultaneous exposure to topical insecticides (DEET and permethrin) and pyrido-stigmine bromide, a drug taken prophylactically to counteract toxic gas warfare agents, causes nervous system damage in chickens and produces symptoms similar to many of those of Gulf War veterans.

Researchers at Tulane University in June 1996 proved that hormone-disrupting chemicals known to cause mild effects produce significantly dramatic hormonal effects when used in combination.[40] Combinations of two or three pesticides, which are commonly found in the environment at low levels, can be up to 1,600 times more powerful in their impact on hormones than any of the pesticides individually. Some chemicals, which individually do not disrupt hormones, greatly magnify the ability of other chemicals to disrupt hormones, which is the case with the chemical chlordane. The Tulane study focused on endosulfan, chlordane, oxaphene and dieldrin, all of which impact a gene making estrogen in animals. Estrogen controls the formation and development of female organs and is strongly associated with both breast cancer and deformity of male sex organs. This research should prompt the EPA to no longer base ALC and regulations on studies of individual chemicals and their individual effects, but rather to regulate combinations of chemicals in order to assure appropriate levels for public safety and protection of aquatic species.

California red-legged frog

Photo by Joyce Gross

BIOLOGICAL EFFECTS OF PESTICIDES

Endocrine Disruption, Sexual Deformities and other Reproductive Anomalies

Endocrine disruptors are synthetic chemicals that mimic natural hormones, disrupting natural processes by sending false messages, blocking real messages, preventing synthesis of the body's own hormones, and accelerating the breakdown and excretion of hormones. Endocrine disruption affects how an organism develops and functions. Reproductive disorders,

Pesticides in a retail store

immune system dysfunction, thyroid disorders, types of cancer, birth defects and neurological effects have all been linked to endocrine disruption. Several organophosphate and carbamate pesticides are recognized as endocrine disruptors.[41]

Endocrine disruption can wreak particularly acute havoc during critical developmental stages of an organism's life.[42] Offspring of those affected by endocrine disruptors may also suffer from lifelong health and reproductive abnormalities, including reduced fertility, altered sexual behavior, lowered immunity, and cancer.[43] Over 60% of all agricultural herbicides applied in the United States (measured by volume) have the potential to disrupt endocrine and/or reproductive systems of humans and wildlife, as numerous studies document.[44]

For example, red-spotted newts (*Notopthalmus viridescens*) exposed in a series of experiments to minute quantities of endosulfan, a commonly-used pesticide, lost reproductive capability.[45] The study noted that endosulfan disrupted the development of glands that synthesize a pheromone used in female communication, resulting in lowered mating success. Especially worrisome, the study revealed an impact at just five parts per billion (ppb), the lowest concentration measured in the study and well within the range of endosulfan contamination levels regularly encountered in our nation's waterways. The EPA's recommendation for acceptable concentrations of endosulfan in surface waters is 74 ppb, almost fifteen times higher than the level found to result in noticeable reproductive impacts. This study also identified a new mechanism by which low-level contamination can cause adverse effects in wildlife populations – interference with chemical information transfer.

Another study suggests that a new and growing class of herbicides (acetolactate synthase or ALS herbicides) can affect non-target plants and microorganisms at levels so low that they cannot even be detected.[46] Still another recent study by the National Academy of Sciences found that amphibians are likely to be far more sensitive to pesticides in the natural world than traditional laboratory tests used to establish regulatory standards would indicate.[47] The study found that low contamination levels of carbaryl cause significant mortality due to the length of exposure. Long-term exposure to low levels of carbaryl in combination with added biological stressors, such as the presence of predators, dramatically increased mortality. The study suggests that the current regulatory schemata rely on science that dramatically underestimates the impacts of many pesticides.

In a recent University of California study, the herbicide atrazine was found to disrupt the sexual development of frogs at concentrations 30 times lower than levels allowed by the EPA.[48] Atrazine is the most commonly used herbicide in the United States. This study exposed frogs to low levels of atrazine, levels often found in the environment. Even at these "low" exposures, male frogs' masculine characteristics were prevented from fully forming, while in some cases, male frogs developed eggs in their testes (hermaphroditism). The impacts of these deformities are surely exacerbated in the natural environment because the highest atrazine levels coincide with the amphibian breeding season.

The study noted that the pervasive nature of atrazine at levels that can disrupt sexual development puts aquatic ecosystems at grave risk. The EPA's newly drafted criterion for atrazine for the protection of aquatic life is 12 ppb. However, exposure levels as low as 0.1 ppb result in frog hermaphrodites. Since initial effects may go unnoticed by researchers because they are all internal, exposures at even lower levels may be causing harm. Thus, "exposed populations could decline or go extinct without any recognition of the developmental effects on individuals."[49]

In a recent University of California study, the herbicide atrazine was found to disrupt sexual development of frogs at concentrations 30 times lower than levels allowed by the EPA.

Tadpole deformities caused by pesticides

The impact of pesticides on frogs also was analyzed in a recent Canadian study.[50] The study found that frogs given trace amounts of DDT and other pesticides experience a near-total collapse in their immune systems. The researchers exposed northern leopard frogs (*Rana pipiens*) to small doses of DDT, dieldrin, or malathion. The study found that it took frogs 20 weeks of living in a pesticide-free environment for their immune systems to return to normal.

In a study focusing on the effect of methoxychlor, a substitute for DDT, scientists found that its presence in pregnant mice changed the structure of the male offspring's prostrate.[51] This study also utilized doses regularly encountered in non-laboratory settings.

In yet another study, dieldrin reduced the number of male water fleas (*Galeata mendotae).*[54] Since aquatic arthropods serve as a food source for fish and many other life forms, this study has implications for the entire chain of aquatic life.

A study on the impacts of pesticides on the expected sex ratio of turtle eggs found that the sex ratio was altered by pesticides.

Endocrine disruptors have been found to affect sexual development of salmon as well.[52] Investigating the troubling phenomenon of sexual reversal in salmonids, this study found that the 84% of phenotypic females testing positive for the male genetic marker (or more plainly put, the feminization of developing males) may be attributable to endocrine disrupting compounds such as pesticides.

A study on the impacts of pesticides on the expected sex ratio of turtle eggs found that the sex ratio was altered by the pesticides trans-nonachlor and chlordane.[53] Specifically, the study found that chlordane suppressed testosterone levels in hatchling males and progesterone levels in hatchling females, indicating that chlordane's impact on sexual ratio results from anti-androgenic activity. Trans-nonachlor functions as an estrogen mimic, while chlordane suppressed testosterone levels but not progesterone levels. The study concluded that different hormone disrupting compounds can achieve similar end results via seemingly unrelated biochemical mechanisms.

An *in-situ* (in the field) study of Northern leopard frogs and green frogs from eight breeding sites, four of which were situated in apple orchards, assessed the impacts of pesticides on the reproductive system.[55]

Western painted turtle

Embryos and larvae were subjected to *in-situ* and ambient pond water (laboratory) assays and to toxicity tests of pesticides used in orchards. The *in-situ* embryos and larvae suffered high mortality at some of the orchard sites, while high hatching success was found in the reference sites. The common pesticide diazinon and the formulations Dithane DG, Gunthion 50WP, and Thiodan 50WP, all of which are known to cause mortality, deformities, and/or growth inhibition in embryos and tadpoles, were detected at the *in-situ* sites.

Photo courtesy of USFWS

Another study investigating hormone disruption in amphibians found that exposure to the breakdown products of methoprene "dramatically interfere with normal amphibian development."[56] Laboratory experiments with African clawed frogs (*Xenopus laevis*) showed that the common pesticide S-methoprene itself posed little direct risks to toads at levels commonly encountered in the environment. However, when toads were exposed to methoprene's breakdown products, caused by its reaction with sunlight, water and microorganisms, normal amphibian development was severely disrupted.

California tiger salamanders are particularly susceptible to environmental contaminants.

This study also demonstrates that pesticide breakdown products must be considered to present a realistic picture of the risk to natural populations. In some cases, important effects may only be evident once the experiment focuses on the breakdown products of the active ingredient. But the EPA (as it readily acknowledges) only examines a parent compound's impacts without investigating the deleterious impacts the breakdown products may have on wildlife – whether directly or through the myriad tertiary impacts by which one species' decline precipitates further ecological degradation.

A delay in puberty and reduction in the fertility of rats was found as a result of exposure to the pesticide methoxychlor.[57] The same researchers documented anti-androgenic effects of other commonly used pesticides. The study found that exposure to these pesticides produced diverse reproductive malformations in male rats, including undescended testes, birth defects in the urinary tract opening, vaginal pouches and permanent nipples. The study also documented reproductive effects from exposure of low-levels of the fungicide vinclozilin, raising concern that some of the anti-androgen effects may have no threshold - that they may be initiated through the slightest increase in anti-androgenic pesticides.

In another study, the cumulative effects of multiple pesticides were analyzed to determine if synergistic effects were taking place despite innocuous responses to each chemical in isolation.[58] The study exposed rodents to concentrations of atrazine, aldicarb and nitrate at levels these common pesticides are actually found in the environment. Although no effects were noted to rodents exposed to a single chemical, those subjected to multiple contaminants were found to suffer endocrine, immune and behavioral changes.

Photo by William Flaxington

Experts from a wide variety of disciplines convened in 1998 to jointly review evidence and assess hazards of endocrine disruption.[59] These meetings produced a series of "consensus statements" detailing their conclusions about the state of science regarding endocrine disruption.

The experts were certain of the following:

- Endocrine-disrupting chemicals can undermine neurological and behavioral development and subsequent potential of individuals exposed in the womb or, in fish, amphibians, reptiles, and birds, the egg. Widespread loss of this nature can change the character of human societies or destabilize wildlife populations.
- The developing brain exhibits specific and often narrow windows during which exposure to endocrine disruptors can produce permanent changes in its structure and function. A variety of chemical challenges in humans and animals early in life can lead to profound and irreversible abnormalities in brain development at exposure levels that do not produce permanent effects in adults.
- The seriousness of the problem is exacerbated by the extremely low levels of hormones produced naturally by the endocrine system and needed to modulate and induce appropriate responses. In contrast, many endocrine-disrupting contaminants, even if less potent than the natural products, are present in living tissue at concentrations millions of times higher than the natural hormones. Wildlife, laboratory animals, and humans exhibit adverse health effects at contemporary environmental concentrations of man-made chemicals that act as endocrine disruptors. New technology has revealed that some man-made chemicals are present in tissue at concentrations previously not possible to measure with conventional analytical methods, but at concentrations that are biologically active.
- Thyroid hormones are essential for normal brain function throughout life. Interference with thyroid hormone function during development leads to abnormalities in brain and behavioral development. Similarly, exposure to man-made chemicals during early development can impair motor function, spatial perception, learning, memory, auditory development, fine motor coordination, balance, and attentional processes. In severe cases, mental retardation may result.

Crop duster spraying pesticides

- Man-made chemicals that interfere with sex hormones have the potential to disturb normal sexual development. Wildlife studies of gulls, terns, fishes, whales, porpoises, alligators, and turtles link environmental contaminants with disturbances in sex hormone production and/or action. These effects have been associated with pesticides.
- Commonalities across species in the hormonal mechanisms controlling brain development and function mean that adverse effects observed in wildlife and in laboratory animals may also occur in humans, although specific effects may differ from species to species.

The scientists also expressed concern over the following factors:

- There may not be definable thresholds for responses to endocrine disruptors. In addition, for naturally occurring hormones, too much can be as severe a problem as too little. Consequently, traditional dose-response curves for toxicity do not necessarily apply to the effects of endocrine disruptors.
- Many pesticides affect thyroid function and therefore, may cause neurological abnormalities.

Exposures to pesticides at current environmental levels have demonstrable adverse effects, even though the study of endocrine disruption and developmental and behavioral effects (and their interaction with the environment) is in its early stages. Endocrine disruption is not limited to interference with natural estrogen levels; it includes androgen blockers, progesterone blockers, compounds that interfere with the thyroid, and others. The current information available on pesticides and their endocrine-disrupting effects raises significant and grave concerns regarding their chronic cumulative impact on humans and other animals, including imperiled species supposed to be protected by law.

The endangered Atlantic salt marsh snake may be threatened by pesticides.
(Listed in table on p. 44)

Photo courtesy of USFWS

OTHER WILDLIFE IMPACTS

Beyond impacting wildlife through endocrine and/or reproductive disruption, pesticides may adversely affect wildlife through direct toxicity or indirectly by modifying the availability of food or adequate habitat. for the majority of bird kills in California, affecting songbirds, waterfowl, and raptors. Shockingly, as many as seventeen birds die for every five acres treated with carbofuran.

The American Bird Conservancy estimates that 672 million birds are directly exposed to pesticides from agricultural uses alone each year and that more than 67 million birds will die from the exposure.

Studying the impact of pesticides used for corn, researchers with the North Carolina Cooperative Extension Service noted both direct and indirect effects.[60] Quail suffered direct impacts. A single aerial insecticide application sickened more than 30% of the quail tested. Once sick, wild birds may neglect their young, abandon their nests, and become more susceptible to predators and disease. Indirect effects on birds included reduction in insect and plant food as a result of insecticides and herbicides, as well as reduction in needed vegetative cover. Of course, many of these pesticides – such as carbofuran, chlorpyrifos, ethoprop, methomyl, methyl parathion, and terbufos – are highly toxic to birds.

In 1999, the Pesticide Action Network of North America released a report, *Disrupting the Balance: Ecological Impacts of Pesticides in California*, which documented the impact of organophosphate and carbamate pesticides on wildlife.[61] The report found that multiple pesticides are often found in California waters and sediments at concentrations that exceed levels lethal to zooplankton, the primary food source for young fish.

The report also observed the routine occurrence of toxic pulses of diazinon and chlorpyrifos in California streams during critical stages in fish development. Additionally, the report documents that carbofuran and diazinon are responsible

Tragic consequences for birds and fish occur from the legal application of pesticides each year. The American Bird Conservancy estimates that 672 million birds are directly exposed to pesticides from agricultural uses alone each year and that more than 67 million birds will die from the exposure.[62] Carbamate and organophosphate (OP) pesticides have been linked with many bird kills (termed "incidents" by the EPA). For example, carbofuran, a carbamate, is estimated to kill one to two million birds annually in the U.S.[63] Many of these organophosphates and carbamates have also resulted in massive fish kills.

Bald Eagles at Reelfoot National Wildlife Refuge, Tennessee

Photo courtesy of USFWS

A stark, but unfortunately not unique, example was seen in Louisiana in 1991 where more than one million fish, and a multitude of other wildlife including alligators, turtles, snakes, and birds, were killed during six legal azinphos-methyl applications.[64] Hundreds of these "incidents" occur annually, resulting in untold mortalities and unknown indirect impacts to wildlife.

According to the U.S. Department of Agriculture, we are facing an "impending pollinator crisis," in which both wild and managed pollinators are disappearing at alarming rates.

The impact of pesticides on pollinators also raises significant environmental concern. According to the U.S. Department of Agriculture, we are facing an "impending pollinator crisis," in which both wild and managed pollinators are disappearing at alarming rates.[65] This crisis has been attributed, in part, to pesticides.[66] Federally endangered or threatened pollinators which may be adversely affected by pesticides include the Sanborn's lesser long-nosed bat, Mexican or big long-nosed bat, Kirtland's warbler, Golden-cheeked warbler, five Hawaiian honeycreepers (Nukupu'u, Hawaii Akepa, Maui Akepa, Po'ouli, and O'u), Kauai Oo, Palila, Maui parrotbill, Laysan finch, Niho finch, and Hawaiian crow.[67] Although pesticides have been identified as a threat to these listed species, the EPA has made no effort to change this.

Swallowtail butterfly and bee on a thistle

Further decline in these imperiled pollinator species jeopardizes reproduction of specific plants that have evolved to take advantage of their unique roles. It is unknown what tertiary impacts could result from the disappearance of these plants and animals. An unknown fraction of threatened and endangered plant species could be adversely affected or jeopardized by pesticide-caused reductions in their pollinators. Plants that are insect-pollinated are also potentially at risk, because most insecticides are broad-spectrum.

Bees, including native solitary bees and bumblebees, which are effective pollinators, are known to be highly sensitive to many pesticides. Bees are affected by pesticides, insecticides and herbicides used for agriculture, forestry and commercial/urban purposes. Bees can be directly exposed to pesticides through contamination while seeking pollen in blooms, as well as through spray drift. Contaminated bees may also introduce toxins into their hives, exposing bee larvae as well. Due to their low fecundity rate, it may take three to four years for bumble bee populations to return to pre-pesticide application levels. Many oligolectic bees (narrowly specialized to visit one or a few species of flower) have small populations but are 'below the radar screen' of the federal listing process, and could be rendered extinct without public awareness. Bumblebee populations are in very bad shape in cotton-growing areas, where they are exposed to repeated applications of insecticides while foraging.[68]

Photo courtesy of USFWS

PESTICIDE USE THREATENS THE SURVIVAL OF ENDANGERED SPECIES

Desert pupfish

Pesticide use is rampant in the United States. Investigations into the potential consequences lag far behind. It is clear that pesticides are finding their way into ecosystems throughout the nation and that many wildlife species are exposed to them in numerous ways. The impact to species on the verge of extinction is sometimes difficult to ascertain. Yet, it is not difficult to infer that pesticide presence at toxic levels in areas used by species listed under the Endangered Species Act as threatened or endangered, potentially threatens their survival.

ENDANGERED SPECIES WHICH MAY BE AFFECTED BY PESTICIDES

There are currently 1,265 federally endangered or threatened species across the United States.[69] Pages 19 through 44 detail some of the threatened and endangered species that the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and/or the EPA acknowledge may be affected by pesticides. Unfortunately, this is only a sampling of the many species that may be affected by pervasive use of pesticides across the country. It is evident from examination of Federal Register notices in which the FWS and NMFS list species, that the agenciesrecognize that pesticides pose a threat to many listed fish, insects, aquatic invertebrates, mollusks, crustaceans, mammals, birds, amphibians, reptiles, and plants throughout the United States. Unfortunately, the EPA has not taken this acknowledgment seriously and for many of these species has done nothing to limit or otherwise mitigate pesticide use in its process of registering pesticides. By failing to consult with the FWS and NMFS, which have the statutory authority and responsibility to cooperate with other agencies in assessing impacts of agency actions and authority on threatened and endangered species, the EPA neglects to comply with federal law or even develop the information base for making the wise and cautious decisions the public expects.

Photo by John Rinne

PACIFIC REGION SPECIES

SAN JOAQUIN KIT FOX
Location: CA

The San Joaquin kit fox (*Vulpes macrotis mutica*), the smallest member of the dog family in North America, inhabits grasslands in the San Joaquin Valley of California. The area's intensive agricultural use exposes foxes to a wide array of pesticides and rodenticides. The FWS has determined that the use of pesticides and rodenticides threatens the endangered San Joaquin kit fox.[70] Hundreds of kit foxes were destroyed historically by strychnine poisoned bait put out for coyote control. Rodent poisoning programs that eliminated ground squirrels reduced the kit fox prey base.

Although the federal government began controlling use of rodenticides in 1972 and prohibited above-ground application of strychnine within the range of the kit fox in 1988, two San Joaquin kit foxes died in 1992 on federal lands as a result of secondary poisoning from other rodenticides. The EPA has recorded several instances where San Joaquin kit foxes have been killed recently by rat poison containing brodifacoum, a deadly rodenticide widely available to the public as an active ingredient in rat and mouse baits such as Talon, Havoc, and D-Con.

San Joaquin kit fox pups at night

BUENA VISTA LAKE SHREW
Location: CA

The tiny Buena Vista Lake shrew (*Sorex ornatus relictus*) lives in the marshes and wetlands of the southern San Joaquin Valley and feeds primarily on insects. According to the FWS, the Buena Vista Lake shrew may be "directly exposed to lethal and sublethal concentrations of pesticides from drift or direct spraying of crops, canals and ditch banks, wetland or riparian edges, and roadsides where shrews might exist,"[71] due to the close proximity of shrew habitat to an otherwise agriculturally dominated landscape. The FWS also noted that "[r]educed reproduction in Buena Vista Lake Shrews could be directly caused by pesticides through grooming [mammals exposed to pesticides may ingest them through grooming as they try to clean their fur], and secondarily from feeding on contaminated insects."[72] The listing notice for the shrew acknowledged the endocrine-disrupting effects of carbamates and organophosphates, noting that "laboratory experiments have shown that behavioral activities such as rearing, exploring for food, and sniffing can be depressed for up to six hours in the common shrew from environmental and dietary exposure to sublethal doses of a widely used insecticide, dimethoate." Such depression in behavioral activities could make the shrews more vulnerable to predation and starvation. Furthermore, shrews may have higher concentrations of pesticides in their system than would normally be available because they may feed heavily on toxic arthropods after pesticide applications. Finally, the FWS notes that Fresno, Kern, and Tulare counties, where the shrew lives, are the three highest users of pesticides in California.

Photo by Rawge at www.rawge.com

HAWAIIAN HOARY BAT
Location: HI

Known locally as the *'ope'ape'a*, the Hawaiian Hoary bat (*Lasirus cinereus semotus*) is the only existing native terrestrial mammal known to occur in the Hawaiian archipelago. The hoary bat is today found on Hawai'i, Maui, O'ahu, Kaua'i and Moloka'i with unconfirmed observations from Kaho'olawe. The FWS notes that pesticides may indirectly impact the bat.[73]

SOUTHWESTERN WILLOW FLYCATCHER
Location: AZ, CA, CO, NV, NM, TX, UT

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a small bird that catches insects within and above dense riparian vegetation along rivers, streams, and other wetlands. The FWS noted that the proximity of Southwestern willow flycatcher habitat to agricultural areas indicates a potential threat from pesticides.[74] The FWS concluded that pesticides may potentially affect the flycatcher through direct toxicity or effects on their insect food base.

Southwestern willow flycatcher

CALIFORNIA TIGER SALAMANDER
Location: CA

California tiger salamander

The California tiger salamander (*Ambystoma californiense*) is a colorful amphibian that breeds in seasonal ponds or vernal pools and is particularly susceptible to environmental contaminants. The FWS has noted that pesticides may affect both the Santa Barbara County and the Sonoma County populations of the California tiger salamander.[75] The State of California and USGS conducted studies in Santa Barbara County sampling well and ground water at 156 locations throughout the range of the tiger salamander. More than 2.2 million pounds of agricultural chemicals were used in 1994 alone on the five major crop types grown on or near tiger salamander sites in Santa Barbara County. More than 3.1 million pounds were applied in 2000 in Sonoma County. Among those chemicals thought to be harmful to tiger salamanders were chlorpyrifos, acephate, fenamiphos, malathion, methyl bromide, metam sodium, azinphos-methyl, maneb, and endosulfan. However, the FWS noted that the identified pesticides provide only a sample of the actual and potential threats. The FWS highlighted the presence of certain pesticides, such as chlorpyrifos, because amphibians, with their permeable skins, readily absorb the chemical – especially when migrating through recently treated fields. The FWS also noted that the use of azinphos-methyl in the vicinity of the tiger salamander could affect recruitment and survival directly, or affect the food supply.

Flycatcher photo by Suzanne Langridge,USGS
Salamander photo by Gerald and Buff Corsi

CALIFORNIA TIGER SALAMANDER, cont.

Finally, the FWS cited studies reporting severe toxicity to amphibians from exposure to endosulfan, including extensive paralysis, delayed metamorphosis and high death rates. The FWS noted that "[I]t is apparent that endosulfan is extremely toxic at low concentrations to amphibians." The FWS concluded that five of the six metapopulations of California tiger salamanders breeding sites in Santa Barbara County "may be directly or indirectly affected by toxic agricultural chemical contaminants because there is intensive agriculture within their drainage basins," and that "all but one of the remaining documented salamander breeding sitesin Sonoma County may be directly or indirectly affected by toxic landscaping chemicals." Additionally, the FWS stated that "[e]ven if toxic or detectable amounts of pesticides are not found in the breeding ponds or groundwater, salamanders may still be directly affected, particularly when chemicals are applied during the migration and dispersal seasons."[76]

MOUNTAIN YELLOW-LEGGED FROG
Location: CA

The mountain yellow-legged frog (*Rana muscosa*) is thought to be declining in part due to pesticide drift from the Central Valley into the high Sierra lakes and streams that harbor the species. The FWS has noted that airborne contaminants may affect the Southern California population of the mountain yellow-legged frog.[77] Airborne pesticides from the west side of the Sierra from Central Valley agriculture are thought to be at least partially responsible for the decline of mountain yellow-legged frogs in the Sierra Nevada.[78] Since mountain yellow-legged frogs spend much of their life cycle in water, moving through the interface of water and air, and respire through their skin, they are at high risk from chemical pollutants. Pesticides, often insoluble in water, tend to concentrate on the surface, a place where mountain yellow-legged frogs move through often, heightening their risk. The species' unique overwintering behavior also makes it particularly vulnerable to pollutants. Both adults and tadpoles overwinter on or in the sediments of lakes, ponds, and slow moving rivers. These sediments become repositories of concentrated organochlorides and other pollutants. Mountain yellow-legged frogs can be repeatedly exposed to these toxic sediments for up to nine months each year.


Mountain yellow-legged frog

Of great concern is the possibility that pesticide pollutants act as environmental stressors, rendering mountain yellow-legged frogs more susceptible to aquatic pathogens such as red-leg disease or the chytrid fungus. These aquatic pathogens historically have been considered opportunistic, infecting only injured or immuno-suppressed amphibians, but not healthy individuals. Recent research indicates that sub-lethal levels of organophosphate pesticides in combination with normal background levels of red-leg bacteria may result in fatal infections to amphibians.[79] More recent data from the Sierra Nevada strongly implicates pesticide drift as a factor for frog declines in general and also specifically for yellow-legged frog declines.[80]

Photo by William Flaxington

CALIFORNIA RED-LEGGED FROG
Location: CA

The California red-legged frog (*Rana aurora draytonii*) is California's largest native frog, and is exposed to pesticides in the wetlands, ponds, and streams in inhabits. The species has disappeared from more than 70% of its historic range in California. The FWS recognized the threat of pesticides in its *Draft Recovery Plan for the Red-Legged Frog*, noting that agricultural practices are introducing pesticides into the red-legged frog's range. In the *Final Recovery Plan for the California Red-Legged Frog*, the FWS concluded that exposure to wind-borne agrochemicals may be an important factor in the decline of the species.[81] FWS noted a strong relationship between increasing levels of upwind agriculture and the percentage of extirpated California red-legged frog sites; in the Sierra Nevada-Central Valley region the percentage of upwind land in agriculture for sites where the species has disappeared was 6.5 times greater than for sites where the species still lives.

The FWS noted that pesticide contamination may result in deformities, abnormal immune system functions, diseases, injury, and death. Ranid tadpoles are likely to be killed or paralyzed by some herbicides such as triclopyr, and insecticides such as fenitrothion.[82] The FWS listed 150 pesticides or herbicides used within the same one square mile section as known California red-legged frog sites or their habitat. The FWS pointed to 25 chemicals of particular concern, including acephate, azinphos-methyl, carbaryl, chlorpyrifos, diazinon, difocol, disulfoton, endosulfan, esfenvalerate, fenamiphos, glyphosate, malathion, mancozeb, methamidophos, methoprene, naled, paraquat, permethrin, phosmet, pyrethrins, strychnine, triclopyr, and trifluralin.

ARROYO TOAD
Location: CA

The arroyo toad (*Bufo californicus*) is restricted to shallow gravel pools adjacent to sandy terraces in rivers in southern California. The FWS noted that pesticide applications as well as other long-term factors likely rendered habitat for the arroyo toad in agricultural fields a "population sink" meaning death rates exceed birth rates, resulting in a local population incapable of maintaining itself without immigration of replacement toads from other habitats.[83] The FWS went on to state that the use of pesticides and herbicides within or adjacent to arroyo toad habitat may cause adverse impacts to the species.

Arroyo toad

Photo courtesy of SCV History in Pictures

BLUNT-NOSED LEOPARD LIZARD
Location: CA

Blunt-nosed leopard lizard

The blunt-nosed leopard lizard (*Gambelia silus*) is a large, striped lizard found in grasslands and alkali sinks in the San Joaquin Valley. The lizard utilizes small mammal burrows and forages on insects. FWS has noted that use of pesticides may directly and indirectly affect blunt-nosed leopard lizards. The insecticide malathion has been used since 1969 to control the beet leafhopper and its use may reduce insect prey populations.[84] Aerial application of malathion may reduce the availability of food for reproducing lizards in the spring, and later for hatchlings when they should be storing fat to sustain themselves during their first winter. The California Department of Food and Agriculture treats areas on the west side of the San Joaquin Valley with malathion up to three times each year. Fumigants, such as methyl bromide, are used to control ground squirrels. Because leopard lizards often inhabit ground squirrel burrows, they may be inadvertently poisoned.

GIANT GARTER SNAKE
Location: CA

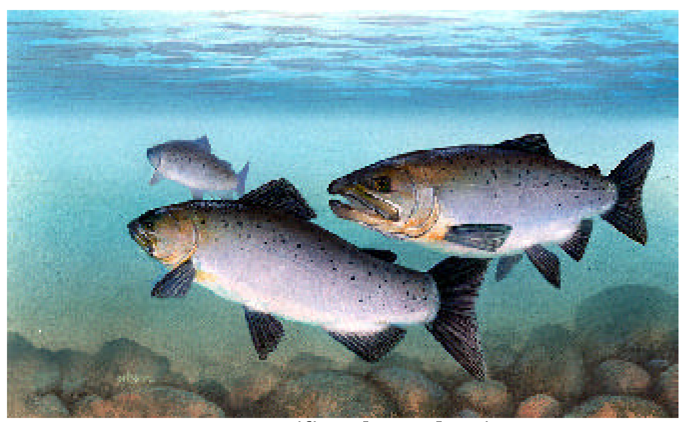
The giant garter snake (*Thamnophis gigas*) is one of the largest garter snakes, endemic to wetlands in the Sacramento and San Joaquin Valleys of California. The FWS has acknowledged that pesticides could adversely affect giant garter snake populations by degrading water quality and reducing prey populations. Heavy use of pesticides is suspected as a contributing factor in the decline of this once abundant species.[85]

Giant garter snake

Garter snake photo courtesy of USFWS
Leopard lizard photo by John Sullivan/Ribbit Photography

PACIFIC SALMON SPECIES
Location: CA, ID, OR, WA

Pacific salmon, including endangered and threatened runs of coho salmon (*Oncorhynchus kisutch*), chinook salmon (*O. tshawytscha*), sockeye salmon (*O. nerka*), chum salmon (*O. keta*), and steelhead trout (*O. mykiss*), depend on clean water during the freshwater stages of their complex life cycles. Many runs of Pacific salmon are threatened by pesticide pollution of rivers and streams within their range. The U. S. Geological Survey studied five major river systems in Washington, Idaho, Oregon, and California, states which contain most of the remaining range of anadromous fish outside of Alaska, and found at least 35 pesticides in each watershed. The USGS found sixteen pesticides in concentrations exceeding their ALC, threatening salmonid growth, development, behavior, and reproduction. Pesticides can also impair swimming ability and avoidance of predators, cause abnormal sexual development, interfere with growth and feeding, and disrupt the salmon's navigating abilities to return to its natal stream to spawn. Pesticides can further indirectly affect fish by changing the aquatic environment, by reducing the food supply, and by eliminating vegetative cover used by young salmon. Fishing and environmental groups recently obtained a court order preventing the use of more than 30 harmful pesticides in no-spray buffers near salmon streams in California, Oregon, and Washington. Pesticides have profound effects on Northwest salmon and may be a significant factor in their decline. The NMFS has noted that pesticides and herbicides also contaminate numerous water bodies and destroy aquatic life necessary for salmonid survival.[86] The EPA itself acknowledged in pesticide registration documents that approved uses of at least 36 pesticides used in the Pacific Northwest are expected to have a negative impact on salmon. These include the organophosphate insecticides azinphos methyl, carbaryl, diazinon, and malathion; and the herbicides 2,4-D, diuron, and trifluralin.[87] Azinphos methyl has caused massive fish kills throughout the U. S.[88] Studies show that exposure to 2,4-D impairs trout swimming ability.[89] Triluralin has been shown to cause bone abnormalities.[90] All of these pesticides are found in harmful concentrations in Pacific northwest waters within the range of listed salmon species.[91] Diazinon has been found in northwest streams at levels that reduce production of testosterone by male salmon, which may weaken the chances that salmon will successfully mate.[92]



Pacific salmon drawing

Drawing by Timothy Knepp,USFWS

DELTA SMELT
Location: CA

The delta smelt (*Hypomesus transpacificus*) is a nearly translucent steely-blue fish found only in the brackish waters of the Sacramento-San Joaquin Delta estuary. The FWS *Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes* noted that the estuary receives flushes of high concentrations of agricultural pesticides, such as carbofuran, chlorpyrifos, and diazinon.[93] The California State Water Resources Control Board states that all the important water bodies in the smelt's range are impaired by one or more contaminants, commonly including pesticides such as diazinon, chloropyrifos, malathion, chlordane, DDT and dieldrin. Recent research indicates that toxicity of certain contaminants in smelt habitat is not constant but occurs in episodes, often in runoff from rainstorms following periods of use of the chemicals. The FWS has noted that acutely toxic pulses of pesticides move down the rivers and through the estuary with "remarkable persistence and relatively little dilution."[94]

Researchers report episodic toxicity in winter associated with organophosphate pesticide treatment of dormant orchards; carbofuran and chlorpyrifos in the San Joaquin River and Delta in spring, possibly associated with treatment of alfalfa; rice pesticides in late spring and early summer with release of rice field water; and a variety of herbicides from irrigation tailwater during the summer.[95] Peaks of numerous other chemicals, including the herbicides trifluralin and atrazine, have also been found.[96] It is unknown what direct effect these toxins have on delta smelt, but there is growing evidence that other fish species in the Delta are suffering direct mortality or additional stress from the presence of toxic substances. There is also evidence that the plankton upon which the smelt feed may be depleted by these highly concentrated pulses of pesticides through the Delta.

OHLONE TIGER BEETLE
Location: CA

The Ohlone tiger beetle (*Cicindela ohlone*) is a brilliant green beetle found only on coastal prairie terrace habitat in Santa Cruz County, California. The ESA listing designation for the species stated that "pesticides could pose a threat to the Ohlone tiger beetle."[97] Specifically, the FWS noted that the beetle could be killed from aerial drift or runoff into Ohlone beetle habitat. The FWS further stated that as development increases, "negative impacts from pesticides may become more frequent," and that although the significance of pesticide effects is unknown, "they are recognized as a substantial potential threat to the species." The FWS concluded that along with other factors, pesticides "imperil the continued existence of this species."

Ohlone Tiger Beetle

Photo by Richard Arnold, Entomological Consulting Services

SANTA ANA SUCKER
Location: CA

The Santa Ana sucker (*Catostomus santaanae*) is designated as threatened in the Los Angeles River, San Gabriel River, and Santa Ana River basins of California. The FWS noted that both point and non-point source pollution (e.g. urban runoff) have significantly degraded the water quality in most of the native range of the Santa Ana sucker.[98] FWS also noted that the use of pesticides on golf courses frequently results in maximum contaminant level exceedences for various pesticides. Consequently, the Santa Ana sucker may be adversely affected from pesticide runoff associated with urban uses such as golf course and turf or lawn treatment.

CALLIPPE SILVERSPOT BUTTERFLY,
BEHREN'S SILVERSPOT BUTTERFLY
and
BAY CHECKERSPOTBUTTERFLY
Location: CA
CARSON WANDERING SKIPPER
Location: CA, NV
FENDER'S BLUE BUTTERFLY
Location: OR

The Callippe Silverspot butterfly (*Speyeria callippe callippe*) is found at two sites on grasslands in the San Francisco Bay Area and the Behren's Silverspot butterfly (*S. zerene behrensii*) is found within coastal terrace prairie at one site in southern Mendocino County, California. According to the FWS, the use of insecticides would threaten both butterflies if use occurred in proximity to occupied habitat.[99] The FWS noted that silverspot butterfly larvae are extremely sensitive to pesticides and even the accumulation of runoff in the soil after spraying has proven lethal to the larvae of members of the genus Speyeria, the silverspots.

In designating critical habitat for the Bay checkerspot butterfly (*Euphydryas editha bayensis*), FWS noted that application or drift of pesticides may affect its critical habitat.[100] For the Carson wandering skipper (*Pseudocopaeodes eunus obscurus*), the FWS noted that pesticide drift from alfalfa fields into a neighboring nectar sites could eliminate a large portion of its population.[101] The FWS identified the use of pesticides and biological control agents to control insect pests, such as the gypsy moth, as a threat to the Fender's blue butterfly (*Icarica icarioides fenderi*).[102] The FWS noted that although the sensitivity of Fender's blue butterfly larvae to specific insecticides is not known, the potential threat from the use of gypsy moth control agents in Fender's blue habitat should not be dismissed. The FWS identified pesticide spraying as an activity that would likely be considered a violation of the ESA.

Bay Checkerspot Butterfly

Photo by Dr. Richard Arnold, Entomological Consulting Services

IDAHO SNAIL SPECIES
Location: ID

Five rare Idaho freshwater snail species are restricted to a few isolated free-flowing reaches or spring alcove habitats in the middle Snake River. Water contamination from pesticides has been listed as a concern for the Idaho springsnail (*Fontelicella idahoensis*), Utah valvata snail (*Valvata utahensis*), Snake River physa snail (*Physa natricina*), Banbury springs limpet (*Lanx sp.*), and Bliss rapids snail (*Taylorconcha serpenticola*).[103]

KAUAI CAVE WOLF SPIDER and KAUAI CAVE AMPHIPOD
Location: HI

The use of pesticides for golf courses was identified as a threat to two Hawaiian cave species, the Kauai cave wolf spider (*Adelocosa anops*) and the Kauai cave amphipod (*Spelaeorchestia koloana*).[104] Golf courses exist on, or are proposed for, the land directly above or adjacent to both populations of the spider and all but one population of the amphipod. The FWS identified at least 30 different pesticides that are used on golf courses in Hawaii. The FWS cited a study finding that predators, such as the Kauai cave wolf spider, are generally more susceptible to insecticides than the target pests. The FWS noted that chronic effects, such as reduced fecundity, reduced lifespan, slowed development rate, and impaired mobility and feeding efficiency are all associated with pesticides. Furthermore, the FWS stated that pesticide use on residential property also poses a "serious threat" to the species.

VENTURA MARSH MILKVETCH and OTAY TARPLANT
Location: CA

Otay Tarplant

A large number of Pacific coast plants are threatened by herbicide and pesticide use. For example, the FWS noted that Ventura marsh milk-vetch (*Astragalus pycnostachyus var. lanosissimus*) and the Otay tarplant (*Deinandra conjugens*) both have small fragmented ranges, making them especially vulnerable to anthropogenic events such as nearby use of pesticides.[105] For the Ventura marsh milk-vetch, the FWS also noted that future suburban and urban uses near the vetch's preserve can bring expected increases in uses of herbicides and pesticides in proximity of the vetch which could harm the milk-vetch directly, or alter the pollinator or plant associations upon which it depends.

Photo courtesy of CalPhotos

HOWELL'S SPECTACULAR THELYPODY
Location: OR

The FWS acknowledged that Howell's spectacular thelypody (*Thelypodium howellii spectabilis*) is "particularly vulnerable to herbicide use" as herbicides may impact pollinator populations.[106] The likelihood of herbicide use in Howell's spectacular thelypody habitat was supported by the known invasion of noxious weeds into those habitats.

Howell's Spectacular Thelypody

ROUGH POPCORNFLOWER
Location: OR

Rough Popcornflower

The FWS noted that pesticides and herbicides have an indirect effect on rough popcornflower (*Plagiobothrys hirtus*) because the plant relies on pollinators to reproduce and these insect pollinators are vulnerable to pesticides.[107] The FWS stated that pesticides have a direct effect on the plant when sprayed in the spring and summer by "reducing seed set, which negatively affects populations of the species."

Thelypody photo by Andrew Kratz
Popcornflower photo by Dr. Ivo Tosevski

BAKER'S and YELLOW LARKSPUR
Location: CA

Baker's larkspur (Delphinium bakeri), a perennial herb in the buttercup family, currently has one known population with about 35 individuals. The yellow larkspur (Delphinium luteum), is also highly endangered with only two known remaining populations, with fewer than 50 individuals. FWS believes that pesticide applications in the range of these plants are not likely to result in a violation of the ESA when such activity is conducted in accordance with consultation under section 7 of the ESA.[108] Unfortunately, the EPA has not consulted on the impacts of pesticides on these endangered larkspurs so it is possible that pesticide applications could result in harm to these species.

Baker's larkspur

SPALDING'S CATCHFLY
Location: ID, MT, OR, WA

The Spalding's catchfly (*Silene spaldingii*) is a long-lived perennial herb whose grassland habitat once was widespread in the region but has been reduced by more than 95 percent. Currently, there are only 52 locations where the catchfly is found, containing a total of about 16,500 plants. The majority of remaining Spalding's catchfly populations are extremely small and isolated, often bordering agricultural fields or rangelands. The catchfly suffers from both direct and indirect impacts of pesticides. Reduced pollinator activity is associated with poor reproductive success, particularly in small populations of the catchfly.

Agricultural fields do not provide suitable habitat for pollinators of *S. spaldingii*, which requires pollination by insects for maximum seed set and population viability. Populations that occupy small areas surrounded by land that does not support bumblebee colonies (e.g. crop lands) are not likely to persist over the long term. Beyond indirect impacts of insecticides and herbicides on pollinators, the catchfly may be directly affected by herbicide applications in adjacent agricultural fields.[109] The FWS notes that the ESA consultation process will address activities including herbicide spraying, yet the EPA has never sought consultation on pesticide impacts to the catchfly.[110]

Photo by Doreeen Smith

SOUTHWEST REGION SPECIES

CACTUS FERRUGINOUS PYGMY OWL
Location: AZ

The cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*) is a small southwestern raptor that nests in cavities in trees or in large columnar cactus. Pesticides are considered a threat to the pygmy owl where it occurs in floodplains that are now largely agricultural.[111] The FWS noted that more than 100 pesticides are used year-round on agricultural crops throughout the lower Rio Grande Valley. Additionally, the FWS noted that "[p]esticide contamination is described as 'widespread' throughout the inland waters of the lower Rio Grande Valley. The FWS concluded that "[w]ithout appropriate precautions, these agents may potentially affect pygmy-owls through direct toxicity or effects on their food base." Despite the acknowledged threat of pesticides, the EPA has not consulted with the FWS on the impact to the pygmy owl of its action to register pesticides.

Cactus ferruginous pygmy owl

CHIRICAHUA LEOPARD FROG
Location: AZ, NM

The Chiricahua leopard frog (*Rana chiricahuensis*) is a stocky leopard-spotted frog found in springs, streams, ponds, and lakes in Arizona and New Mexico. According to the FWS, pesticides may be a contributing or causal factor in the decline of the Chiricahua leopard frog.[112] Pesticides have also been implicated in the decline of other species of ranid frogs.[113]

BARTON SPRINGS SALAMANDER
Location: TX

The Barton Springs salamander (*Eurycea sosorum*) is a slender yellowish-cream color amphibian only found in its namesake watershed, a popular public swimming hole near Austin, Texas. Barton Springs salamanders have been developing strange deformities and dying of bizarre maladies. Pesticides in Barton Springs were described by the FWS as a threat to the salamander because of amphibians' recognized sensitivity to contaminants. The FWS cited the exposure to certain cylcodienes (endosulfan, endrin, toxaphene, and dieldrin) and organophosphates (parathion, malathion, and diazinon) as a threat to amphibians, noting that "since the salamander is fully aquatic, there is no possibility for escape from contamination."[114] The agency not only cited the threat of direct exposure but also indirect effects of pesticides on the quality and quantity of amphibian food.

In 2002, the FWS suggested that the EPA enter into formal consultation regarding the impact of atrazine on the Barton Springs salamander.[115] The FWS also cited concern about other pesticides – specifically, diazinon, atrazine, prometon, metolachlor, carbaryl, and simazine – due to findings from the USGS which found all of these pesticides in the Barton Springs watershed. Although numerous scientific studies link pesticide use with significant developmental, neurological and reproductive effects to amphibians, the EPA has refused to consult with the FWS regarding the impact of pesticides on the Barton Springs salamander.

Photo by Robin Silver

KEMP'S RIDLEY SEA TURTLE
Location: AL, CT, DE, FL, GA, LA, MD, MA, MS, NC, NJ, NY, RI, SC, TX, VA

The Kemp's ridley sea turtle (*Lepidochelys kempii*) nests on beaches in the Gulf of Mexico and juvenile turtles frequent bays, coastal lagoons and river mouths. The FWS and the EPA believe pesticides used near the Texas coast might threaten the Kemp's ridley sea turtle.[116] The pesticide atrazine has been shown to disrupt the hormonal system in sea turtles, which can impact their reproductive success.

Kemp's ridley sea turtle

DESERT PUPFISH
Location: AZ

Desert pupfish (*Cyprinodon macularius*), which survive in only a few isolated Mojave Desert springs, can tolerate water heated to 113 degrees and twice as salty as the ocean. However, they cannot tolerate exposure to pesticides. Drift from aerial application of pesticides has contributed to the decline of pupfish in Quitobaquito Springs, Arizona.[117] Aerial pesticide application is a common practice near other natural populations in California and Mexico, which may be similarly impacted.

TEXAS INVERTEBRATE SPECIES
Location: TX

Water contamination from pesticides has been listed as a concern for the Comal Springs riffle beetle (*Heterelmis comalensis*) and Comal Springs dryopid beetle (*Stygoparnus comalensis*), small aquatic insects restricted in distribution to spring sites in Comal and Hays Counties, Texas.[118] Nine cave-dwelling invertebrates found in Bexar County are also threatened by pesticides. *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name), *Batrisodes venyivi* (Helotes mold beetle), *Texella cokendolpheri* (Robber Baron Cave harvestman), *Cicurina baronia* (Robber Baron cave spider), *Cicurina madla* (Madla's cave spider), *Cicurina venii* (no common name), *Cicurina vespera* (Vesper cave spider), and *Neoleptoneta microps* (Government Canyon cave spider) cave habitat is susceptible to degradation from pesticide runoff.[119] The FWS concluded that pesticide applications in or near karst features that contain any of the nine invertebrates, or areas that drain into these karst features, could potentially result in the violation of the ESA prohibitions against harm to these species.

HOLMGREN and SHIVWITS MILK-VETCH
Location: AZ, UT

Holmgren milk-vetch (*Astragalus holmgreniorum*) and Shivwits milk-vetch (*A. ampullarioides*) are endangered perennial herbs found near the Arizona-Utah border. The FWS recognized indirect effects of pesticides on both plant species.[120] Pollination for these species was identified as a long-term concern, as the FWS acknowledged that increased pesticide use may affect pollinators which in turn would impact both milk-vetch species.

Shivwits milk-vetch

Milk-vetch photo by Renee Van Buren
Turtle photo courtesy of Texas Parks & Wildlife, Bill Reaves(c)2004

GREAT LAKES–BIG RIVERS REGION SPECIES

BALD EAGLE

Location: ***AL, AR, AZ, CA, CO, CT, DC, DE, FL, GA, ID, IL, IN, IA, KS, KY, LA, MA, MD, ME, MI, MN, MS, MO, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY***

Bald eagle

Historical declines of the bald eagle (*Haliaeetus leucocephalus*) were attributed in large part to the widespread use of DDT before it was banned in 1972. DDT and other organochlorine compounds accumulate in eagles causing eggshell thinning and reproductive failure.

The bald eagle continues to be threatened by the use of several pesticides, including the organophosphate insecticides terbufos, fonofos, and phorate; warfarin, an anticoagulant rodenticide; and the insecticide carbofuran. The FWS has been urging the EPA to cancel all forms of carbofuran since the early 1990s because of its extreme toxicity to wildlife. According to the FWS, illegal use of carbofuran and other highly toxic chemicals for predator control has killed a number of bald eagles.[121] The National Wildlife Health Research Center has diagnosed over one hundred cases of pesticide poisonings in bald eagles in the past fifteen years.[122]

Contaminants can affect the health, survival and reproductive success of bald eagles, as well as the abundance and quality of prey. Although pesticides in recent times have not impacted the bald eagle on a population level, individual poisonings still occur from carcasses baited with poison for coyotes, through poisoned predatory animals eaten by eagles, and crop insecticides taken up by prey animals.[123] Long-term exposure to contaminants is a much more extensive problem than is direct mortality, since lifetime exposure may limit an eagle's reproductive capabilities, alter their behavior and foraging abilities, and increase their susceptibility to diseases or other environmental stresses.[124]

PALLID STURGEON

Location: ***AR, IL, IA, KS, KY, LA, MO, MI, MT, ND, NE, SD, TN***

The prehistoric-looking pallid sturgeon (*Scaphirhynchus albus*) is one of the largest and rarest fish of the Missouri and Mississippi River basins. According to the FWS, pollution is likely a threat to the species.[125] Detectable concentrations of the pesticides dieldrin and chlordane, which is very highly toxic to fresh water invertebrates and fish, have been found in pallid sturgeon in the Missouri River. Pesticides may adversely affect developing eggs of sturgeon, development of embryos, or survival of fry, thereby reducing reproductive success, due to the long egg maturation cycle of the pallid sturgeon combined with the tendency for certain contaminants to be concentrated in eggs.

Release of pallid sturgeon

Both photos courtesy of USFWS

HINE'S EMERALD DRAGONFLY
Location: AL, IL, IN, MI, MO, OH, WI

The Hine's emerald dragonfly (*Somatochlora hineana*) exhibits a unique mix of natural beauty and engineering, with its slender, metallic body with green, brown or black coloring and yellow lateral strips marking the thorax. Due to the proximity of Hine's emerald dragonfly habitat to apple and cherry orchards, pesticide drift and runoff was identified by the FWS as a potential threat to the species.[126]

Hine's Emerald Dragonfly

ILLINOIS CAVE AMPHIPOD
Location: IL

The Illinois cave amphipod (*Gammarus acherondytes*) is a small cave-dependent species inhabiting the dark zone of cave streams. The amphipod is threatened primarily by degraded groundwater caused by the application of agricultural and residential pesticides and other contaminants.[127] Of particular concern is runoff during spring and summer rainstorms when demonstrated peak levels of pesticides are much higher than than acceptable limits and may be lethal to the species. Additionally, the FWS noted that groundwater contamination, including pesticides, affects the amphipod's habitat. The Illinois State Geological Survey (ISGS) analyzed water samples from nine springs, one cave stream, and 33 wells. The study detected atrazine and/or alachlor in 83% of the samples taken from springs in the study area.[128] Atrazine is one of the most commonly used herbicides in Monroe County, where the amphipod is found. The levels found in these samples often exceeded the EPA maximum contaminant levels of 2.0 ppb and 3.0 ppb, respectively, during and following spring rainfalls. Atrazine concentrations in spring samples were found as high as 98 ppb. The maximum level found in the Illinois Caverns was 1.38 ppb. However, studies have demonstrated acute toxicity to amphipods from a 48-hour exposure to atrazine at 2.4 parts per million (ppm).

Furthermore, the ISGS study reported reproductive effects and impaired survival of offspring from concentrations as low as 0.14 ppm. Another study, by Mayer and Ellersieck (1986), reported that Gammaridae were most sensitive to the insecticides carbaryl, DDT, endrin, malathion, and methoxychlor and postulated that pesticide pulses characteristics of karst springs could have major impacts on biota such as amphipods. Malathion and carbaryl were noted by the FWS to be among the most commonly used insecticides in the region. The FWS concluded that "[w]hile direct mortality cannot be conclusively attributed to such agricultural chemicals as atrazine, carbaryl, DDT, or malathion…the presence of such contaminants in the amphipod's environment constitutes strong circumstantial evidence that the deterioration of water quality is the primary cause of the decrease in the species' range and the number of extant populations."[129]

Photo by Paul Burton

HUNGERFORD'S CRAWLING WATER BEETLE
Location: MI

The Hungerford's crawling water beetle (*Brychius hungerfordi spangler*) is a small water beetle found in only five isolated locations in Michigan and Ontario, Canada. The four Michigan sites are in the Cheboygan River watershed and may be affected by agricultural and lawn pesticide pollution.[130]

MITCHELL'S SATYR BUTTERFLY
Location: IN, MI

The Mitchell's satyr butterfly (*Neonnympha mitchellii mitchellii*) is one of the most geographically restricted eastern butterflies. Historically, the Mitchell's satyr was found in New Jersey, Ohio, Michigan, Indiana, and possibly Maryland. Today it can only be found in 13 locations in Michigan and two locations in Indiana. Mitchell's satyr is a wetland dependent species. FWS recognized contamination of wetlands from pesticide runoff from adjacent agriculture as a threat to its existence.[131]

Mitchell's satyr butterfly

NORTHERN WILD MONKSHOOD
Location: IA, NY, OH, WI

Northern wild monkshood (*Aconitum noveboracense*) is a purple flower in the buttercup family which grows only in moist soil pockets at the bottom of sandstone or limestone cliffs. In 1998 the EPA reported that application of oxyfluorfen, an herbicide used to control roadside vegetation, had killed northern wild monkshood.[132]

Northern wild monkshood

SCALESHELL MUSSEL
Location: AR, MO, OK, SD

The scaleshell mussel (*Leptodea leptodon*) is a filter feeder that lives in the substrate of medium to large-sized rivers within the Mississippi River basin. Surface run-off of pesticides was noted by the FWS as an apparent "contributing factor" in the degradation of the Scaleshell mussel's habitat.[133] The FWS went on to state that "many of the same threats that caused the extirpation of historical populations of scaleshell mussels still exist and continue to threaten extant populations," and that pesticide registration is a federal activity that may impact the mussel.

Monkshood photo by J. Selby
Butterfly photo by Dr. Richard Arnold, Entomological Consulting Services

SOUTHEAST REGION SPECIES

WOOD STORK
Location: AL, FL, GA, SC

The wood stork (*Mycteria americana*) is a large, long-legged wading bird with a wingspan of over five feet. Significant pesticide levels have been reported in wood storks, with some eggshell thinning, but this has apparently not yet adversely affected reproduction.[134] The FWS informed the EPA in 1989, when the EPA consulted on the re-registration of the insecticide endosulfan, that endosulfan use jeopardized the continued existence of the wood stork. The EPA ignored a FWS recommendation that the registration of endosulfan be cancelled.

Wood stork

GRAY BAT
Location: AL, AR, GA, KS, KY, IN, IL, OK, MS, MO, NC, TN, VA

The gray bat (*Myotis grisescens*), 3 to 4 inches in length, is the largest species of *Myotis* found in the eastern United States. The FWS notes that overuse of pesticides and pesticide poisoning has contributed to the gray bat's decline.[135] The core range of the gray bat encompasses the cave regions of Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Populations also occur in portions of Florida, Georgia, Kansas, Indiana, Illinois, Oklahoma, Mississippi, Virginia, and possibly North Carolina.

LOWER KEYS MARSH RABBIT
Location: FL

The Lower Keys marsh rabbit (*Sylvilagus palustris hefneri*) builds mazes of runs, dens, and nests in brackish coastal marshes or freshwater inland marshes. This endangered rabbit may be exposed to pesticides used in its marsh habitat and may also come in contact with poisons used to control black rats.[136] These contaminants can either be ingested while foraging on plants or drinking water. In a 1993 Biological Opinion, the FWS investigated the effects of vertebrate control agents on endangered and threatened species and determined that several chemicals, such as Pival, would jeopardize the continued existence of the Lower Keys marsh rabbit. Pival is a rodenticide used to kill rats and is lethal if ingested. The FWS also concluded that if development in the Keys continues to increase, the potential for rabbits to come in contact with such chemicals also increases, as does the potential for their extinction. Based on these findings, the FWS concluded that use of such chemicals will result in deaths of Lower Keys marsh rabbits.

Photo by Dr. Lloyd Glenn Ingles

MISSISSIPPI GOPHER FROG
Location: MS

The Mississippi gopher frog (*Rana capito sevosa*) is a stubby subterranean frog that utilizes gopher tortoise and mammal burrows in the lower coastal plain of the Mississippi River and Mobile River Deltas. In designating the Mississippi gopher frog as endangered, the FWS recognized that pesticides may affect the species.[137] The FWS cited four separate peer-reviewed studies in recognizing the multiple impacts pesticides have on frogs throughout their life cycle.

ALABAMA CAVEFISH
Location: AL

The Alabama cavefish (*Speoplatyrhinus poulsoni*) is a blind albino fish known only from Key Cave, Lauderdale County, Alabama. According to the FWS, application of pesticides to row crops on land immediately around and above Key Cave may impact the cavefish.[138]

SPRUCE-FIR MOSS SPIDER
Location: NC, TN

The spruce-fir moss spider (*Microhexura montivaga*) is a tarantula-like spider found on damp moss mats on boulders in high-elevation fir and spruce forests. In designating critical habitat for the Spruce-fir moss spider, the FWS noted that the species is "extremely vulnerable to extirpation from a single event or activity such as … pesticide/herbicide application."[139] The FWS also identified pesticide applications as an activity that may also jeopardize the continued existence of the species.

ATLANTIC COAST PIPING PLOVER
Location: AL, CT, DE, FL, MA, MD, ME, NC, NH, NJ, SC, VA

Piping Plover

The Atlantic Coast piping plover (*Charadrius melodus*) is a sand colored shorebird that breeds on coastal beaches from Newfoundland to South Carolina. The EPA failed to reply to a request from the FWS for consultation on the impacts of the pesticide fenthion and ignored the FWS recommendation that its registration be cancelled, despite the fact mortality of at least one plover was documented from fenthion use.[140] The registration of fenthion was voluntarily cancelled by the manufacturer in 2003.

Photo by Sidney Maddock

EASTERN INDIGO SNAKE
Location: AL, FL, GA, SC

The Eastern indigo snake (*Drymarchon corais couperi*) is a large, docile, non-poisonous, shiny bluish-black snake growing to a maximum length of about eight feet. Pesticides that bioaccumulate through the food chain may present a potential hazard to the species. Pesticides used on crops or for silviculture would pose a pulse effect to the indigo.

Secondary exposure to rodenticides used to control black rats may also occur.[141] The FWS has discouraged use of poison to control rats in areas inhabited by this species since indirect poisoning of snakes may occur.[142] The USGS also notes that agricultural insecticides are a contributing factor to its decline.[143]

Indigo Snake

VERMILION DARTER
Location: AL

The vermilion darter (*Etheostoma chermocki*) is a freshwater fish with reddish-orange sides and belly, and a bright red spot on the dorsal fin of males. According to the FWS, pesticides from runoff that washes into stream habitat for the vermillion darter currently threaten the sole surviving population of the species.[144] In fact, pesticide runoff from urban use was responsible for at least one fish kill incident, and that heavy pesticide runoff could result in extirpation of the species given its limited distribution. The FWS also stated that pesticide registration was one of several federal activities that could impact the darter.

ARMORED SNAIL
and SLENDER CAMPELOMA
Location: AL

The armored snail (*Pyrgulopsis pachyta*) and slender campeloma (*Campeloma decampi*) are freshwater snail species restricted to a few isolated sites in Alabama. The FWS identified pesticides as a threat to both snail species because their habitat is dominated by agricultural use.[145] Specifically, the FWS identified habitat for both species in three drainages which are susceptible to pesticide contamination because of the agricultural use in those drainages. The FWS noted that pesticides were found in two of the three drainages during a site visit in 1997. However, despite a request from the FWS to federal agencies (including the EPA) that may have programs that might adversely affect the species, the FWS did not receive any responses. It is startling that the EPA did not respond to the FWS request despite the fact that the FWS highlighted pesticides as a threat to both species and found pesticides present in the species' habitat.

Photo by E.R. Degginger

CAROLINA HEELSPLITTER
Location: NC, SC
APPALACHIAN ELKTOE
Location: NC, TN

The FWS noted that pesticides threaten the remaining populations of the Carolina heelsplitter (*Lasmigona decorata*) and the Appalachian elktoe (*Alasmidonta raveneliana*), two species of freshwater mollusks.[146] The FWS also specifically identified pesticide applications as an activity that may destroy or adversely modify critical habitat for both species. Additionally, the FWS stated that the previously identified activities (including pesticide applications) also have the potential to jeopardize the existence of both species and that federal agencies are already required to consult with the FWS on these type of activities. Despite the FWS announcement that pesticide application activities require consultation, EPA has failed to initiate such consultation.

ALABAMA SNAIL SPECIES
Location: AL

Water contamination from pesticides has been listed as a concern for the cylindrical lioplax snail (*Lioplax cyclostomaformis*), flat pebble snail (*Lepyrium showalteri*), painted rocksnail (*Leptoxis taeniata*), plicate rocksnail (*Leptoxis plicata*), round rocksnail (*Leptoxis ampla*),and lacy elimia (*Elimia crenatella*).[147]

SCHAUS SWALLOWTAIL BUTTERFLY
Location: FL

Schaus swallowtail butterfly

The Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*) is limited to tropical hardwood hammocks in the upper Florida Keys. Commercial pesticide and insecticide use has contributed to the decline of the swallowtail. Spraying for mosquito control still occurs in swallowtail habitat in Monroe County, Florida, including the pesticides Dibrom, Baytex, and Teknar, which are toxic to the related giant swallowtail in the laboratory.[148] Use of these pesticides causes direct mortality of Schaus swallowtail butterflies and indirectly affects the species by application to food sources and other components of the habitat. The FWS believes it very likely that extensive mosquito control using these pesticides has greatly reduced butterfly populations.[149]

Photo by George Krizek,USFWS

NORTHEAST REGION SPECIES

LOGGERHEAD SEA TURTLE
Location: AL, CA, CT, DE, FL, GA, HI, LA, MD, MA, MS, NC, NJ, NY, OR, RI, SC, TX, VA

Pesticides have been detected in sea turtles, including in their eggs, but levels which result in adverse effects have not been quantified.[150] Loggerhead sea turtles (*Caretta caretta*) in Chesapeake Bay are exposed to harmful concentrations of the herbicide atrazine. Atrazine may disrupt the hormonal system of sea turtles, impacting their reproductive success. According to the EPA, atrazine runoff in Chesapeake Bay also destroys habitat and food sources for sea turtles.[151]

Loggerhead sea turtle

DWARF WEDGE MUSSEL
Location: CT, MD, MA, NC, NH, NJ, NY, PA, VT, VA

Adventurous larvae of the dwarf wedge mussel (*Alasmidonta heterodon*) attach to a fish host, suspected to be an anadromous fish which migrates from the ocean into freshwater to spawn. The dwarf wedge mussel is now known from only a dozen sites and one of the largest known populations, where the Ashuelot River meanders through a golf course, declined dramatically from 1985 to 1990. In listing the species, the FWS attributed the decline to fungicides, herbicides, insecticides; fertilizers applied to the golf course as well as agricultural runoff from abutting cornfields and pastures.[152]

ATLANTIC SALMON
Location: ME

Wild Atlantic salmon (*Salmo salar*) in Maine rivers are at an all-time low, with less than 50 adult fish returning to spawn in recent years, and face a number of threats that could drive them to extinction. According to the FWS, chronic exposure to insecticides, herbicides, fungicides, and pesticides (in particular those used to control spruce budworm) impact the Maine population of Atlantic salmon.[153] The FWS noted that pesticide application even in compliance with label restrictions could result in violations of section 9 prohibitions against take.

INDIANA BAT
Location: AL, AR, GA, IA, IL, IN, KS, KY, MD, MI, MO, MS, NC, NJ, NY, OH, OK, PA, SC, TN, VT, VA, WV

The FWS listed pesticides as a threat to the Indiana bat (*Myotis sodalis*) and noted that pesticides have been implicated in the declines of a number of other insectivorous bats in North America. Studies of the related little brown bat (*M. iucifugus*) and the northern long-eared bat (*M. septentrionalis*) in northern Missouri suggested that bats there may be exposed to significant amounts of organophosphate and/or carbamate insecticides applied to agricultural crops, especially those applied to corn.[154] Further studies of tissue and guano samples from five species of bats in Missouri documented their exposure to DDE, heptachlor epoxide, and dieldrin.[155]

Photo by John White

MOUNTAIN-PRAIRIE REGION SPECIES

WYOMING TOAD
Location: WY

The Wyoming toad (*Bufo baxteri*) is extremely rare – only one small population remains. The use of the herbicide atrazine is known to decimate populations of frogs of the genus *Bufo* (which includes the Wyoming toad) and can be introduced into watersheds in sufficient levels to kill eggs or tadpoles.[156] The FWS noted in the proposed listing for the Wyoming toad that atrazine is widely available throughout the Laramie Basin, where the species occurs, and that other herbicides such as Tordon are also used.[157]

The FWS informed the EPA in 1989, when the EPA consulted on the re-registration of the insecticide endosulfan, that endosulfan use jeopardized the continued existence of the Wyoming toad. The EPA ignored FWS recommendation that the registration of endosulfan be cancelled. The FWS noted that Weed and Pest Districts commonly use herbicides for noxious weed control in roadside ponds and field edges typically used by the Wyoming toad. Application of Fenthion with diesel fuel for mosquito control began in 1975 in the Laramie Basin. The FWS believes that this mosquito control technique, with very little control of spray drift, may be highly toxic to bufonids, as there is evidence that shows diesel fuel alone is highly toxic to amphibians.

TOPEKA SHINER
Location: IA, KS, MO, MN, NE,SD
ARKANSAS SHINER
Location: AR, KS, NM, OK, TX

The Topeka shiner (*Notropis topeka*) is a small minnow that inhabits headwater prairie streams with good water quality and cool temperatures. The FWS stated that due to a lack of riparian vegetation buffer strips, pesticide application for agricultural purposes has the potential to impact the Topeka shiner, particularly through runoff following heavy precipitation events.[158] The FWS noted that "there are presently numerous areas along streams without buffers that may impact the species." For the Arkansas River shiner (*Notropis girardi*), FWS referred to the section 7 consultation process, mentioning that the EPA will consider the shiner in the registration of pesticides. However, EPA has yet to consider the shiner in any pesticide registration.[159]

Topeka shiner

Photo by Konrad Schmidt

PREBLE'S MEADOW JUMPING MOUSE
Location: CO, WY

The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) has a long tail and long feet adapted for jumping. The FWS listing decision for the Preble's meadow jumping mouse noted that pesticide and herbicide use has undoubtedly increased across the species' range as human land use has intensified.[160] According to the FWS these chemicals could directly poison mice or be ingested through contaminated food or water.

PAWNEE MONTANE SKIPPER
Location: CO

The Pawnee montane skipper (*Hesperia leonardus montana*) is a small brownish-yellow butterfly found on granite outcrops in ponderosa pine habitat in the South Platte River drainage. The FWS noted in the listing determination for the Pawnee mountain skipper that use of insecticides for mountain pine bark beetle or other pests within the range of the species could result in the loss of individual butterflies or populations.[162]

NEOSHO MADTOM
Location: KS, OK, MO

The Neosho madtom (*Noturus placidus*) is a small catfish up to three inches long. When listing the species, the the FWS explicitly alerted the EPA that upon listing, the EPA will need to reinitiate ESA consultation on the registration and re-registration of pesticides.[161] Despite the request to initiate consultation, the EPA has refused to comply, allowing pesticides to continue to threaten the madtom's existence.

Pawnee montane skipper

Photo courtesy of USFWS

OTHER SPECIES AFFECTED BY PESTICIDES

The list of other species that may be affected by pesticide use is long but still incomplete (see pages 43 and 44). It includes numerous fish, amphibians, reptiles, birds, mammals, insects, aquatic invertebrates, clams, snails, and plants.

Pesticides are used extensively throughout the United States, jeopardizing aquatic and terrestrial species. However, little is known about the impacts occurring on the ground and in the water. Lists are compiled for different purposes by different organizations and there is no single database that identifies species at risk from pesticide use. In California alone however, the California Department of Pesticide Regulation has compiled a list of species whose habitat overlaps with pesticide use at the section level (one square mile), which totals 179 federally listed, proposed and Category 1 candidate species.[163]

The Audubon Society's "watch list" is composed of species facing population declines and/or threats such as habitat loss on their breeding and wintering grounds, or with limited geographic ranges. The watch list identifies pesticides as a risk to the bay-breasted warbler, black rail, black swift, McCown's longspur, Lewis woodpecker, white-throated swift, buff-breasted sandpiper, calliope hummingbird, Gunnison sage-grouse, Hawaiian coot (pictured), Allen's hummingbird, California thrasher, olive-sided flycatcher, Pacific golden-plover, American golden-plover, Antillean nighthawk,short-eared owl, wrentit, rufous hummingbird, and short-billed dowitcher.[164]

The EPA has abdicated its statutory responsibility to investigate and develop information on species affected by pesticide use. When environmental groups identify a species that may be affected by pesticide use, the EPA's usual answer is that there is not enough information to confirm the impacts. Instead of embracing the precautionary principle and restricting pesticide use while more information is gathered, the EPA shifts the evidentiary burden to those seeking to protect species from pesticide impacts.

Hawaiian coot

Photo courtesy of USFWS

Louisiana Black Bear
Sonoran Pronghorn
Bighorn Sheep
Point Arena Mountain Beaver
Riparian Brush Rabbit
Mount Graham Red Squirrel
Northern Idaho Ground Squirrel
Amargosa Vole
Hualapai Mexican Vole
Pacific Pocket Mouse
Salt Marsh Harvest Mouse
Southeastern Beach Mouse
Fresno Kangaroo Rat
Giant Kangaroo Rat
Morro Bay Kangaroo Rat
San Bernardino Kangaroo Rat
Stephen's Kangaroo Rat
Tipton Kangaroo Rat
Riparian Woodrat
Cape Sable Seaside Sparrow
Dusky Seaside Sparrow
Florida Grasshopper Sparrow
San Clemente Sage Sparrow
Indiana Bat
Lesser long-nosed Bat
Mexican long-nosed Bat
California Clapper Rail
Light-footed Clapper Rail
Yuma Clapper Rail
Laysan Finch
Niho Finch
Mountain Plover
Western Snowy Plover
California Least Tern
Interior Least Tern
Audubon's Crested Caracara
Brown Pelican
California Condor
Coastal California Gnatcatcher
Eskimo Masked Bobwhite
Everglade Snail Kite
Florida Scrub Jay
Inyo California Towhee
Least Bell's Vireo
Marble Murrelet
Northern Aplomado Falcon
Northern Spotted Owl
Red-cockaded Woodpecker
San Clemente Loggerhead Shrike
Short-tailed Albatross
Whooping Crane
Amber Darter
Bayou Darter
Bluemask (Jewel) Darter
Boulder Darter
Cherokee Darter
Duskytail Darter
Etowah Darter
Fountain Darter
Goldline Darter
Leopard Darter
Maryland Darter
Niangua Darter
Okaloosa Darter
Relict Darter
Slackwater Darter
Snail Darter
Watercress Darter
Ash Meadows Specked Dace
Blackside Dace
Desert Dace
Foskett Speckled Dace
Kendall Warm Springs Dace
Moapa Dace
Spike Dace
Big River Spinedace
Little Colorado Spinedace
White River Spinedace
Apache Trout
Coastal sea-run Cutthroat Trout
Gila Trout
Greenback Cutthroat Trout
Lahontan Cutthroat Trout
Little Kern Golden Trout
Paiute Cutthroat Trout
Beautiful Shiner
Blue Shiner
Cahaba Shiner
Cape Fear Shiner
Palezone Shiner
Pecos Bluntnose Shiner
Devil's River Minnow
Loach Minnow
Rio Grande Silvery Minnow
Gila (Yaqui) Topminnow
Big Bend Gambusia
Clear Creek Gambusia
Pecos Gambusia
San Marcos Gambusia
Pygmy Madtom
Scioto Madtom
Smoky Madtom
Yellowfin Madtom
Bonytail Chub
Borax Lake Chub
Chihuahua Chub
Cowhead Lake Tui Chub
Hutton Tui Chub
Humpback Chub
Mohave Tui Chub
Oregon Chub
Owen's Tui Chub
Pahranagat Roundtail Chub
Slender Chub
Sonora Chub
Spotfin Chub
Virgin River Chub
Yaqui Chub
Ash Meadows Amargoa Pupfish
Comanche Springs Pupfish
Devil's Hole Pupfish
Leon Springs Pupfish
Owen's Pupfish
Warm Springs Pupfish
June Sucker
Lost River Sucker
Modoc Sucker
Razorback Sucker
Shortnose Sucker
Warner Sucker
Hiko White River Springfish
Railroad Valley Springfish
White River Springfish
Gulf Sturgeon
Shortnose Sturgeon
Conasauga Logperch
Roanoke Logperch
Chui-ui
Colorado Squawfish
Ozark Cavefish
Pahrump Poolfish
Pygmy Sculpin
Tidewater Goby
Unarmored Three Spine Stickleback
Waccamaw Silverside
Woundfin

Yaqui Catfish
Alameda Whipsnake
Atlantic Salt Marsh Snake
New Mexico Ridge-nosed Rattlesnake
San Francisco Garter Snake
Coachella Valley Fringe-toed Lizard
Island Night Lizard
Bog Turtle
Green Sea Turtle
Leatherback Sea Turtle
Hawksbill Sea Turtle
Yellow-Bloched Map Turtle
Desert Tortoise
Desert Slender Salamander
Flatwoods Salamander
San Marcos Salamander
Santa Cruz long-toed Salamder
Sonora Tiger Salamander
Texas Blind Salamander
Houston Toad
Puerto Rican Crested Toad
Guajon
Alabama Cave Shrimp
California Freshwater Shrimp
Conservancy Fairy Shrimp
Kentucky Cave Shrimp
Longhorn Fairy Shrimp
Riverside Fairy Shrimp
San Diego Fairy Shrimp
Vernal Pool Fairy Shrimp
Vernal Pool Tadpole Shrimp
Hay's Spring Amphipod
Noel's Amphipod
Lee County Cave Isopod
Madison Cave Isopod
Nashville Isopod
Socorrro Isopod
Cave Crayfish
Shasta Crayfish
Alabama Lamp Pearlymussel
Appalachian Monkeyface Pearlymussel
Birdwing Pearlymussel
Cumberland Bean Pearlymussel
Cumberland Monkeyface Pearlymussel
Curtis' Pearlymussel
Dromedary Pearlymussel
Green-blossom Pearlymussel
Higgin's Eye (Pearlymussel)
Orange-footed Pearlymussel
Little-wing Pearlymussel
Pale Lilliput Pearlymussel
Purple Cat's Paw Pearlymussel
Tubercled-blossom Pearlymussel
Turgid-blossom Pearlymussel
White Cat's Paw Pearlymussel
White Wartyback Pearlymussel
Yellow-blossom Pearlymussel
Cumberland Pigtoe
Dark Pigtoe
Fine-rayed Pigtoe
Rough Pigtoe
Shiny Pigtoe
Southern Pigtoe
Fat Pocketbook
Finelined Pocketbook
Ouachita Rock-Pocketbook
Speckled Pocketbook
Arkansas Fat Mucket
Orange-nacre Mucket
Pink Mucket
Ovate Clubshell
Southern Clubshell
Coosa Moccasinshell
Alabama Maccasinshell
Jame's Spinymussel
Tar River Spinymussel
Cumberland Elktoe
Cumberlandian Combshell
Fat Threeridge
Inflated Heelsplitter
Louisiana Pearlshell
Oyster Mussel
Purple Bankclimber
Purple Bean
Rough Rabbitsfoot
Shinyrayed Slabshell
Southern Acornshell
Stirrup Shell
Tan Riffle Shell
Triangular Kidneyshell
Upland Combshell
Anthony's Riversnail
Iowa Pleistocene Snail
Koster's Tryonia
Newcomb's Snail
Morro Shoulderband Snail
Pecos Assminea
Roswell Springsnail
Royal Snail
Tulotoma Snail
El Segundo Blue Butterfly
Lange's Metalmark Butterfly
Lotis Blue Butterfly
Mission Blue Butterfly
Myrtle's Silverspot Butterfly
Oregon Silverspot Butterfly
Palos Verdes Blue Butterfly
Quino Checkerspot Butterfly
Saint Francis' Satyr
San Bruno Elfin Butterfly
Sacramento Mountains Checkerspot Butterfly
Smith's Blue Butterfly
Blackburn's Sphinx Moth
Kern Primrose Sphinx Moth
Ash Meadows Naucori
Delhi Sands Flower-loving Fly
Laguna Mountains Skipper
Valley Elderberry Longhorn Beetle
Zayante Band-Winged Grasshopper

WHAT IS THE EPA DOING TO CONTROL THE USE OF PESTICIDES?

The Federal Insecticide, Fungicide, and Rodenticide Act and the Food Quality Protection Act

The EPA is responsible for the oversight of pesticide sales and use in the United States. Specifically, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) charges the EPA with reviewing and registering chemicals for use as insecticides, fungicides, rodenticides, and pesticides (collectively "pesticides") in the United States.[165] A pesticide generally may not be sold or used in the United States unless the EPA has registered it for that particular use.

History of Federal Pesticide Law

FIFRA was enacted in 1947 to address the human health risks posed by pesticide products. In 1972, concerned about long- and short-term toxic effects of pesticide exposure to applicators, wildlife, non-target insects and birds, and food consumers, Congress amended the 1947 version of FIFRA, with the Federal Environmental Pesticide Control Act. The 1972 amendment shifted responsibility for administering pesticides from the U.S. Department of Agriculture to the Administrator of the EPA, and established a program for controlling the sale, distribution, and application of pesticides through an administrative registration process. With Congressional General Accounting Office reports projecting that the process would not be completed until well into the twenty-first century, and frustrated by the EPA's inability to re-register pesticides, Congress again amended FIFRA in 1988.

The 1988 amendments established a comprehensive re-registration program for all pesticides with active ingredients that were initially registered before November 1, 1984, in recognition of rapid advancements in scientific understanding of the effects of pesticides.

The Registration Process

The EPA may register a pesticide only after making the following determinations: (1) the labeling complies with FIFRA's requirements; (2) the composition claims are warranted; (3) the pesticide will perform its intended function; and (4) the pesticide will not cause unreasonable adverse effects on the environment. The culmination of the registration process is the EPA's approval of a label for the particular pesticide, which then may not be used in a manner inconsistent with that label.

Pesticide warning sign

The EPA must classify pesticides for general or restricted use, depending on their particular risks. Where necessary to guard against unreasonable adverse environmental effects, the EPA must classify (or when the information becomes available, reclassify) a pesticide as "restricted." Restricted use pesticides may only be applied by a certified applicator or under the direct supervision of a certified applicator and application must follow all limitations on the frequency, type, location or protective measures associated with its use.

Photo by Gail Hansche

Even after registering a pesticide, the agency retains discretionary involvement and in control over that registration. Furthermore, it must review each registration every fifteen years. The EPA also has the authority to compel registrants to submit data on potentially unreasonable adverse effects that may be necessary for a re-registration review and can cancel pesticide registrations whenever "a pesticide or its labeling or other material required to be submitted does not comply with the provisions of this Act or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment."[166]

The EPA's re-registration decisions require a determination of whether the pesticide causes unreasonable adverse effects to people or the environment when used according to product labeling. This determination is presented in a Re-registration Eligibility Decision (RED) document. The RED comprises a human health assessment and an environmental risk assessment. The FIFRA risk-benefit standard is not a safety standard, but rather a balancing standard under which, in the EPA's own words, workers can be regularly exposed to "unacceptable risks." The environmental assessment evaluates the likelihood that exposure to that pesticide may cause harmful ecological effects. The effects can be direct (e.g. fish die from a pesticide entering waterways), or indirect (e.g. birds become sick or do not reproduce normally after ingesting contaminated fish). The studies conducted during the environmental assessment include: defining the chemical properties of the pesticide; determining how the pesticide behaves in the environment; and assessing its impact on plants and animals not targeted by the pesticide (non-target organisms). Toxicology studies are carried out on plants and animals that have been chosen for testing because they broadly represent non-target organisms. Toxicology studies analyze both acute (short-term) and chronic (long-term) impacts; impacts being mortality of plants and animals as a result of exposure to the pesticide.

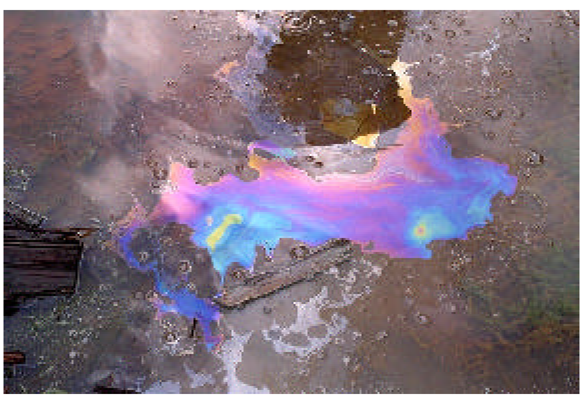
Mattiace Petrochemical pollution, Glen Cove, NY

To determine how the pesticide behaves in the environment, the EPA measures the interaction of the pesticide with soils, air, sunlight, surface water, and ground water. Some of the basic questions that must be answered to determine the "environmental fate" of the pesticide include: how fast and by what means does the pesticide degrade; what are the breakdown chemicals; how much of the pesticide or its breakdown chemicals will travel from the application site; and where will the pesticide or its breakdown chemicals accumulate in the environment. Environmental fate analyses help develop estimates of pesticide concentrations in the environment. The EPA establishes the risk assessment by comparing possible exposures to a pesticide, based on the environmental fate analyses, with resulting harmful effects on plants and animals. The result will indicate the likelihood of mortality to plants and animals from use of the pesticide. However, the risk assessment does not incorporate sub-lethal impacts under its risk assessment evaluation.

Photo courtesy of NOAA

In determining the ecological risk posed by a pesticide (risk characterization), the EPA integrates the results of the exposure and ecotoxicity data to estimate the likelihood of adverse ecological effects. The means of integrating the results of exposure and ecotoxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates (estimated environmental concentrations or EECs) by ecotoxicity values (toxicity endpoint values, such as the median lethal dose (LD_{50}) or the median lethal concentration (LC_{50}), both acute and chronic. RQs are then compared to the EPA's levels of concern (LOCs). The LOCs are criteria used by the EPA to indicate potential risk to non-target organisms.

The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms.



Contaminated water

LOCs address the following risk presumption categories: (1) *acute high* – potential for acute risk is high and regulatory action may be warranted in addition to restricted use classification; (2) *acute restricted use* – the potential for acute risk is high, but may be mitigated through restricted use classification; (3) *acute endangered species* – endangered species may be adversely affected; and (4) *chronic risk* – the potential for chronic risk is high and regulatory action may be warranted. In general, the higher the RQ, the greater the concern. Calculated risk quotients represent a screening level assessment.

Risk characterization provides further information on the likelihood of adverse effects occuring by considering the fate of the chemical in the environment, geographic patterns of chemical usage, communities and species potentially at risk, their spatial and temporal distributions and the nature of the effects observed in the laboratory and field studies. When the RQ exceeds the LOC for a particular category, the EPA presumes a risk of concern to that category.

The types of measures included in Re-registration Eligibility Decisions (REDs) to reduce risks that are of concern include: voluntary cancellation of pesticide products or deletion of uses; declaring certain uses ineligible or not yet eligible (and then proceeding with follow-up action to cancel the uses or require additional supporting data); restricting use of products to certified applicators; limiting the amount or frequency of use; improving use directions and precautions; adding more protective clothing and equipment requirements; requiring special packaging or engineering controls; requiring no-treatment buffer zones; employing ground water, surface water, or other environmental and ecological safeguards; and other measures.

Photo courtesy of NOAA

The EPA also regulates the use of pesticides through the Federal Food, Drug, and Cosmetic Act (FFDCA), which authorizes the EPA to set tolerance levels for pesticides used in or on foods or animal feed. In 1996, Congress further amended FIFRA and the FFDCA with the Food Quality Protection Act (FQPA), which refined safety standards for pesticide residue in food. Under FQPA, the EPA must further determine with "reasonable certainty that no harm" will come to infants, children or other sensitive individuals exposed to pesticides from food, water, and home and garden use. The FQPA also requires that the EPA consider the cumulative effects of different pesticides in evaluating the safety of individual pesticides. However, the cumulative effects consideration does not apply to occupational exposure to pesticides. The EPA satisfies FQPA's requirements by reassessing all existing "tolerances" (maximum limits for pesticide residues in foods) and is using the re-registration program as the vehicle for such analysis.

Interim REDs (IREDs) are issued for pesticides that are undergoing de-registration, require a re-registration eligibility decision, and also must be included in a cumulative assessment under FQPA because they are part of a group of pesticides that share a common mechanism of toxicity. The EPA is issuing IREDs for most organophosphate (OP) pesticides, as OPs share common mechanisms of toxicity. An IRED is issued for each individual pesticide in the cumulative group when the EPA has completed the pesticide's risk assessment and risk management decision. An IRED may include measures to reduce food, drinking water, residential, occupational, and/or ecological risks, to gain the benefit of these changes before the RED can be issued, following the EPA's consideration of cumulative risks for the group.

The EPA also issues Reports on FQPA Tolerance Reassessment Progress and Interim Risk Management Decisions, known as TREDs, for pesticides that require tolerance reassessment decisions under the FQPA but do not require re-registration eligibility decisions at present because: the pesticide was first registered after November 1984; the EPA completed a RED for the pesticide before the FQPA was enacted; or the pesticide is not registered for use in the United States but tolerances are established that allow crops treated with the pesticide to be imported from other countries. Like IREDs, some TREDs will not become final until the EPA considers the cumulative risks of all the pesticides in the cumulative group.

Halby Chemical pollution, Wilmington, DE

The EPA has chosen organophosphate pesticides, a group of closely-related pesticides that affect the functioning of the nervous system as the first priority group of pesticides to be reviewed under FQPA. Consequently, OPs are issued IREDs until the cumulative risks of the OPs have been considered. After the EPA has issued a RED and declared a pesticide re-registration case eligible for re-registration, individual end-use products that contain pesticide active ingredients included in the case still must be reregistered. This concluding part of the re-registration process is referred to as "product re-registration." In issuing a completed RED document, the EPA calls in any product-specific data and revised labeling needed to make final re-registration decisions for each of the individual pesticide products covered by the RED.

Photo courtesy of NOAA

THE EPA'S RESPONSIBILITIES UNDER THE ESA

When a species has been listed as threatened or endangered under the Endangered Species Act, federal agencies have duties under that Act to assess their programs and activities to ensure they do not jeopardize the survival and recovery of the animal or plant in question. The Act prescribes the process to be followed to ensure compliance with each set of duties.

Section 7(a)(2) of the ESA requires that "each federal agency shall, in consultation with and with the assistance of the [Interior] Secretary, insure that any action authorized, funded, or carried out by such agency … is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary . . . to be critical.[167]"

LPC Chemical and marsh

The Act establishes an inter-agency consultation process to assist federal agencies in complying with this duty under Section 7. Federal agencies must consult with the appropriate expert fish and wildlife agency (the Fish and Wildlife Service for terrestrial species and non-oceanic fish species, and the National Marine Fisheries Service for marine species) to determine whether their actions will jeopardize the survival or adversely modify the critical habitat of listed species and, if so, to identify ways to modify the action to avoid that result.

An agency must initiate consultation under Section 7 whenever it undertakes an action that "may affect" a listed species or critical habitat. Conversely, an agency is relieved of the obligation to consult on its actions only when the action will have "no effect" on listed species or designated critical habitat. Effects determinations are based on the direct, indirect, and cumulative effects of the action when added to the environmental baseline and other interrelated and interdependent actions.

Regulations implementing Section 7 broadly define the scope of agency actions subject to consultation to encompass "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies," including the promulgation of regulations and the granting of licenses. Agencies must consult on ongoing agency actions over which the federal agency retains, or is authorized to exercise, discretionary involvement or control. Agencies must also consult on ongoing agency actions "if a new species is listed … that may be affected by the identified action."[168]

The end product of formal consultation is a biological opinion in which the FWS determines whether the action will jeopardize the survival and recovery of listed species or will adversely modify the species' critical habitat. In order to make this determination, the FWS must review all relevant information and provide a detailed evaluation of the action's effects, including the cumulative effects of federal and nonfederal activities in the area, on the listed species.

Photo courtesy of NOAA

The FWS has a statutory duty to use the best available scientific information in an ESA consultation. If the FWS determines that the action is likely to jeopardize the species, the biological opinion must specify reasonable and prudent alternatives that will avoid jeopardy. The FWS must also formulate discretionary conservation recommendations to reduce or minimize the action's impacts on listed species or critical habitat.

Not only does a Section 7 consultation assist the action agency in discharging its duty to avoid jeopardy, but the biological opinion also affects the agency's obligation to avoid the "take" of listed species. Under Section 9 of the ESA, it is illegal for any person -whether a private or governmental entity – to "take" without authorization any endangered species of fish or wildlife listed under the ESA. By regulation, the FWS has made the take prohibition applicable to all threatened species. "Take" is defined to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct. The FWS has defined "harm" to include "significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering."[169]

As part of a consultation, the FWS determines whether to authorize the incidental take of listed species through the issuance of an incidental take statement. An incidental take statement may be issued only if the action can proceed without causing jeopardy. An incidental take statement must: (1) specify the impact of the incidental take on the listed species; (2) specify reasonable and prudent measures the FWS considers necessary to minimize that impact; and if necessary (3) set forth mandatory terms and conditions.

An incidental take statement insulates the federal agency from liability for take of a threatened or endangered species, provided the agency complies with the statement's terms and conditions. This permission to take a species extends to any entity receiving a federal permit, license, authorization, or funding subject to, and in compliance with, the statement. Thus, the ESA provides that: "[A]ny taking that is in compliance with the terms and conditions specified in a written statement provided under subsection (b)(4)(iv) of this section shall not be considered to be a prohibited taking of the species concerned."[170]

Sewer contamination

Beyond Section 7 consultation duties, federal agencies must "utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species and threatened species listed" under the ESA. As defined under Section 3 of the ESA, the term "conservation" means to use all necessary methods and procedures to bring an endangered or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary. As a federal action agency, the EPA must review the programs it administers and consult with the expert fish and wildlife agencies to ensure it utilizes its programs and authorities to conserve listed species – especially in light of the agency's pesticide registration responsibilities.

Photo courtesy of NOAA

THE EPA'S SO-CALLED "ENDANGERED SPECIES PROTECTION PROGRAM"

The EPA displays a stunning lack of initiative in complying with the Endangered Species Act. The agency has shown reckless disregard for the impact of its Pesticide Regulation Program on wildlife, and most importantly, on endangered species. The EPA has made occasional forays in addressing pesticide registrations through ESA consultation, but each attempt has failed to fully assess the impact of the pesticide program on endangered species. More importantly, the EPA has failed to implement an overarching program to address pesticide impacts to endangered species, abrogating its authorities to further conservation of threatened and endangered species as required by Section 7(a)(1) of the ESA.

Dredge discharge pipe

In 1972, the EPA assumed responsibility for registration of pesticides from the U.S. Department of Agriculture. Congress passed the Endangered Species Act in 1973 but the EPA did not begin consultations with the FWS until 1981. Consultations were conducted on a case-by-case basis where an individual pesticide was consulted on for specific uses. Recognizing that the case-by-case approach was inefficient, the EPA adopted a "cluster" approach, where pesticides with similar use patterns were considered together. This approach began in 1983 with a series of biological opinions covering corn, grain, forest, mosquito, and rangeland uses.

In 1989, the EPA reinitiated consultation on the pesticides reviewed in the clusters, focusing on impacts to aquatic species. Additionally, in 1989, the EPA released a proposed "Endangered Species Protection Program" (ESPP),[171] which would establish how future consultations take place. In 1993, the EPA found that the "cluster" approach was also problematic and adopted a species-based approach where they evaluated the impacts of sixteen vertebrate control agents s(i.e. rodenticides) on 56 species (mammals, birds, reptiles, and insects). The EPA intended to consult on another fifteen pesticides but the biological opinion was never completed.

Since 1993, the EPA has continuously referred to the non-finalized 1989 ESPP, deferring ESA compliance until it was finalized. The EPA's view was that previous opinions proved ineffective in assessing the impacts of pesticides and thus an overarching framework was necessary. Consequently, instead of complying with the ESA as pesticides continued to be registered and new species continued to be added to the federal endangered species list, the EPA provided generic statements that it would address ESA issues when the ESPP was finalized.

Of course, each year the EPA claimed it expected the ESPP to be finalized soon. In the interim, the agency has relied on voluntary measures to protect species that received consultation up to 1993. However, since 1993, except in the presence of litigation, the EPA has not completed a single consultation for newly listed species or addressed new scientific information regarding previously consulted species.

Photo courtesy of USFWS

In the interim, species remain in peril while the EPA fails to comply with the ESA. During its consultation period with the EPA in the mid 1980s to early 1990s, the FWS concluded that pesticides jeopardized birds, amphibians, mammals, aquatic invertebrates, fish, and reptiles. The consultations found that pesticides impacted over a hundred species, indicating that registered pesticides clearly threaten the existence of listed species. Yet the EPA has left species unprotected in the interim, as it continuously defers any ESA consultation until the ESPP is finalized. However, inaction for over a decade indicates that this is by no means an "interim" problem to be resolved in the "near future."

The EPA also assumes that it can solve the pesticide problem for endangered species through the use of "county bulletins." Under the proposed program, generic label statements would instruct pesticide users to consult local county bulletins, which would inform the user on how to appropriately apply the pesticide in proximity to endangered and threatened species. Some county bulletins were created after the 1989 consultation to provide protections for species covered in the 1989 biological opinion.

Specifically, the bulletins contained the 1989 biological opinion's reasonable and prudent alternatives to avoid jeopardy. However, the EPA admits that these bulletins are totally outdated as they only provide use instructions for a few species listed prior to 1993. Furthermore, the use of county bulletins is completely voluntary, allowing applicants to use pesticides as they see fit.

The bulletins also have not incorporated use limitations for species listed since 1993, and are used in only a select number of states across the country. Although the EPA never updated the original set of county bulletins, created to implement the mitigation measures deemed necessary by the FWS in the 1989 biological opinion, it states in the 2002 proposed ESPP that county bulletins will be updated annually. Given the EPA's inability to manage a very small number of bulletins covering a limited number of species, it is difficult to believe that the EPA will be able to adequately protect endangered species through the use of county bulletins.

Pollution at Kanai Moose Range, AK

Photo courtesy of USFWS

Consequently, those species whose survival is jeopardized by pesticide use receive no real protections. In 2000 the Director of the FWS, Jamie Rappaport Clark, informed the EPA that "[t]he nonjeopardy findings we rendered in our previous opinions were based on EPA implementing an enforceable county bulletin program. Voluntary compliance shifts the responsibility of enforcing appropriate use limitations from EPA to the Fish and Wildlife Service…. Unless EPA requires mandatory compliance with FIFRA-enforceable pesticide use limitations, there will be no certainty that our consultations on pesticides will result in protective measures for threatened and endangered species."[172] The EPA has yet to require mandatory compliance with the bulletins. These species continue to decline towards extinction while the EPA continues to find ways to avoid compliance with the ESA.

Although the EPA released a second proposed ESPP in 2002,[173] it falls far short of the mandates of the ESA, demonstrating that the EPA still has no real interest in assessing the impacts of pesticides on endangered species. In thirteen years, the EPA has made little progress on addressing pesticide impacts to listed species. For well over a decade the EPA has continuously referred to an ESPP in the works – unfortunately, the new ESPP proposed rule reveals that the EPA was doing little in the interim to find a way to bring its pesticide registration program into compliance with the ESA. Instead, it is astonishingly obvious that the EPA was looking for ways to avoid its ESA obligations.

Edison Insecticide dumping, Edison, NJ

EPA's second proposed ESPP is lacking in several regards. First, the EPA misinterprets its overlapping duties between FIFRA and the ESA. The EPA contends that it must comply with the ESA while "considering the needs of agriculture and other pesticide users," and that "moving forward with a final program implementation scheme did not seem feasible," – though such loopholes are in no way built into the statutes. In fact, the Supreme Court has highlighted that "Congress intended endangered species to be afforded the highest of priorities," and made it clear that prevention of jeopardy is above cost considerations.[174] The agency's proposal to balance impacts to pesticide applicators with its mandatory duty to protect endangered species undermines the purpose of the ESA and places listed species in greater peril.

Furthermore, the EPA has revealed an institutional lack of concern for listed species by proposing that the agency itself, not the Fish and Wildlife Service or the National Marine Fisheries Service, should assess the risk of pesticide registrations on endangered species, and proposing the assessment be done outside of the consultation process.[175] The EPA is not fully qualified or equipped to assume this role. Although EPA staff may have a strong understanding of pesticides, the agency does not have expertise about listed species and cannot, therefore, make requisite effect determinations absent the FWS or the NMFS. In a nod to industry, this inadequate process would also allow opportunities for pesticide manufacturers to contribute to the risk assessment while limiting the opportunity of the expert agencies (FWS and NMFS) to provide oversight.

Photo courtesy of NOAA

The EPA's risk assessment is also fundamentally flawed for numerous reasons. Problematically, the risk assessment screenings are based on effects to organisms and not to habitat, ignoring indirect and chronic effects. The risk assessment only addresses active ingredients of a pesticide, failing to take into account degradate products. Moreover, the EPA's models address one-time events on species, failing to assess the cumulative risk of multiple applications or the use of multiple chemicals within a particular area. The models fail to incorporate site-specific conditions such as water temperature, pH, changes in precipitation, and climate. The assessment fails to address impacts of inert or other ingredients of the pesticide. The EPA models also do not consider species distribution or density, number of species actually exposed, or the concentration and duration of exposure.

Of particular concern is how the EPA estimates the toxicity levels for species. Because their toxicity levels are based on the median lethal concentration, the EPA's determination of allowable pesticide levels is based on mortality and not on potential adverse impacts – while "may affect" is the relevant trigger for consultations prescribed by the ESA. Consequently, the EPA's ecological risk assessment fails to adequately assess sub-lethal effects which harm listed species. These failures, and a misunderstanding of cause and effect, result in an invalid and unlawful effects determination.

Cape May National Wildlife Refuge contaminant area

One example of the EPA's failure to regulate pesticides harmful to endangered species is their consultation with the FWS on re-registration of the insecticide endosulfan. A 2002 FWS letter to the EPA stated that "EPA's discussion of the FWS's biological opinion on endosulfan use is inadequate. It fails to mention that jeopardy opinions were provided in 1989 on those pesticides used for 43 species, including fish and mussel species, as well as the Santa Cruz long-toed salamander, Wyoming toad, Nashville crayfish, piping plover and wood stork. EPA failed to adopt 9 of the 13 reasonable and prudent actions to avoid jeopardy…EPA may be in violation of the Endangered Species Act."[176] The letter concludes: "the U.S. Fish and Wildlife Service does not support the re-registration of endosulfan." The FWS further informed the EPA that "we do not believe that EPA has adequately evaluated or presented the ecological risks of this pesticide...In the event that EPA proceeds with this registration, we believe that sufficient information exists to assume this pesticide is likely to result in numerous adverse effects to threatened and endangered species."

As of this writing there are 103 products with endosulfan for general use and approximately 60 special use registrations for endosulfan. As discussed in this report endosulfan has been implicated in the decline of or is a threat to numerous listed amphibians such as the California red-legged frog, California tiger salamander, mountain yellow-legged frog, and Barton Springs salamander.

Photo courtesy of NOAA

THE EPA AND THE COURTS

Due to the EPA's ongoing recalcitrance in complying with the ESA, many environmental organizations have been forced to seek recourse in the courts. The following is a brief review of resolved and pending lawsuits over the EPA's neglect of endangered species.

Washington Toxics Coalition, et al. v. EPA

Concerned about the impacts pesticides pose to endangered salmonid species in the Pacific Northwest, the Northwest Coalition for Alternatives to Pesticides, Washington Toxics Coalition, Pacific Coast Federation of Fishermen's Associations, and Institute for Fisheries Resources sued the EPA for failing to conduct ESA Section 7 consultations with the NMFS. In July of 2002, the U.S. District Court in Seattle found that the EPA had failed to meet its Section 7 obligations, noting that the EPA's own reports document the potentially-significant risks posed by registered pesticides to salmonids. Specifically, the Court found that the EPA failed to consult on the potential impacts of 54 pesticides on salmon. The EPA was ordered to complete effects determinations and initiate consultation by December 1, 2004. In January of 2004, the Court also restricted the use of 38 pesticides near salmon streams and required point-of-sale warnings on products containing seven pesticides that have polluted urban salmon streams. In May of 2004, the pesticide industry group, CropLife America, along with grower groups, requested a stay of the January 2004 injunction while they appeal the ruling to the Ninth Circuit Court of Appeals. The District Court issued a strongly worded opinion denying the industry request. Lambasting the EPA, the Court stated that "if EPA had expended as much effort in compliance with the ESA as it has expended in resisting this action, the lawsuit might have been unnecessary."[177]

Californians for Alternatives to Toxics, et al. v. EPA

In 2000, Californians for Alternatives to Toxics, the Environmental Protection Information Center, and the Humboldt Watershed Council sued the EPA for failing to consult with the FWS and the NMFS before registering pesticides that may affect six listed salmonids and 33 listed plant species or their critical habitats in California. The plaintiffs settled the lawsuit with a Consent Decree, which establishes deadlines for the EPA to initiate consultation on the potential effects of eighteen pesticides (acrolein, atrazine, bromacil, carbaryl, chlorpyrifos, diazinon, diuron, glyphosate, hexazinone, imazapyr, oxyfluorfen, 2,4-D-2 ethylhexyl ester, molinate, oryzalin, simizine, sulfometuron-methyl, triclopyr butoxyethyl ester, and triclopyr triethylammonium).[178]

Frog deformities caused by pesticides

Center for Biological Diversity v. Whitman

In April of 2002, the Center for Biological Diversity sued the EPA for failing to consult on pesticides that may affect the California red-legged frog. The suit identified 51 pesticides by name, and another 200 pesticides generally, that are used in habitat of the red-legged frog. This suit is still pending.[179]

Center for Biological Diversity v. EPA

Recognizing an ongoing recalcitrance from EPA to address the serious problem pesticides pose to numerous listed species, the Center for Biological Diversity filed a notice of intent to sue the EPA in June of 2002 for violations of the ESA and for violations of the ESA and the Migratory Bird Treaty Act (MBTA) for failure to consult or re-consult on the effects of 45 pesticides on over 300 listed species from Florida to Washington.

Defenders of Wildlife, et al. v. EPA

Defenders of Wildlife, the American Bird Conservancy, and Florida Wildlife Federation filed suit in October of 2002 against the EPA over the registration of fenthion, a mosquitocide that is only used in three counties in Florida. Fenthion is extremely toxic to birds and has been linked to bird kills, including the death of piping plovers, an endangered species. Although the FWS advised the EPA that fenthion poses "unreasonable adverse effects" to the environment, particularly to species protected under the ESA and the MBTA, and suggested that the pesticide be cancelled, the EPA refused to heed these warnings. In 2003, Bayer Environmental Science voluntarily requested that EPA cancel its registrations for all of its products containing fenthion, stating that the decision was based on the fact that the market for the product was very limited.[180]

Natural Resources Defense Council v. EPA

The Natural Resources Defense Council (NRDC) sued the EPA in August of 2003 for failing to consult on the impact of the herbicide atrazine on several listed species. The lawsuit focuses on the EPA's failure to protect sea turtles in the Chesapeake Bay, salamanders in Texas, mussels in Alabama, and sturgeons in Midwest waters from atrazine. Although atrazine is banned in much of Europe, the EPA refuses to ban the herbicide in the U.S. even though its risk assessments acknowledge potential harmful effects of atrazine – both directly and indirectly – on endangered fish, aquatic invertebrates, terrestrial plants and aquatic plants.

A recent University of California study demonstrated that frog larvae exposed to extremely low doses (0.01 ppb) of atrazine resulted in the production of hermaphrodites.[181] However, the EPA concluded that it is not possible to ascertain the relationship of atrazine exposure to developmental effects in amphibians. The EPA's independent Scientific Advisory Panel (SAP) reviewed the literature on developmental effects of atrazine on amphibians and responded to the EPA's conclusion.

Natural Resources Defense Council v. EPA, cont.

The SAP noted that although it could not draw a conclusion regarding a concentration-response relationship, it believes that the data support the hypothesis that the effect of atrazine on amphibian gonadal development occurs with a threshold concentration between 0.01 and 25 ppb.[182]

In a shocking move, the EPA has ignored the overwhelming scientific evidence on the harmful effects of atrazine, and in October 2003 approved the unrestricted use of this pesticide. Under a court-approved consent decree with NRDC under another atrazine suit focused on public health concerns, the EPA was required to further assess the use of this dangerous chemical.[183] However, in a private agreement with Syngenta, the primary producer of atrazine, the EPA required Syngenta to monitor atrazine pollution from 2004 to 2005 in only 3% of the 1,172 watersheds that are at high risk of atrazine contamination.

The EPA has not required any measures to protect the public and wildlife from atrazine use in any of these watersheds. The EPA also alarmingly concluded that atrazine is not likely to cause cancer in humans, despite the August 2003 report from the SAP, which found that atrazine may cause cancer and that the EPA's focus on prostate cancer was potentially misleading.[184]

Center for Biological Diversity v. EPA

In December of 2003, the Center for Biodiversity and the Save Our Springs Alliance brought another suit against the EPA for failing to consult on the impact of six pesticides (including atrazine, diazinon, metolachlor, prometon, and simazine) on the Barton Springs salamander. All six pesticides have been found in samples taken by the USGS from Barton Springs, Texas. Additionally, the FWS alerted the EPA that "it does not appear that EPA will be able to fulfill its legal responsibilities under Section 7(a)(2) of the [ESA] to ensure that its proposed re-registration action [for atrazine] is not likely to jeopardize the continued existence of listed species or destroy or aversely modify designated critical habitat."[185]

The FWS letter identified concern for the Barton Springs salamander given documented adverse affects to amphibians from atrazine exposure. Despite the FWS's concerns, the EPA has not initiated consultation for pesticide impacts to the Barton Springs salamander.

DISCUSSION

Fortunately, much progress has been made by environmental and public health organizations in bringing attention to pesticide issues. As more scientific studies are released documenting the adverse impacts common pesticides have on our environment and public health, education and awareness of these issues grows.

However, the Bush Administration and the EPA continue to employ "avoid and delay" tactics to protect the chemical industry. For more than thirteen years, the EPA has failed to consult under the ESA on the effects of pesticide registrations, and delayed implementation of an Endangered Species Protection Program, all the while jeopardizing numerous listed species from pesticide use. The EPA has shown a callous disregard for the scientific findings that continue to document adverse impacts to wildlife and humans.

The EPA has taken striking and unnerving measures to avoid ESA conflicts with pesticide use. In January of 2004, the EPA released its proposed Joint Counterpart Endangered Species Act Section 7 Consultation Regulations.[186] If finalized, this regulation will circumvent the ESA Section 7 consultation process altogether, not to mention Congressional intent, allowing the EPA itself to decide whether pesticides are likely to adversely affect listed species without any FWS or NMFS oversight. Section 7 regulations require FWS/NMFS concurrence for agency determinations that an action is not likely to adversely affect a listed species. If either FWS or NMFS does not concur with the agency's determination, the agency must enter into formal consultation. Under the EPA's proposed regulation this important check would be eliminated, giving the EPA unilateral power in determining whether a pesticide must be consulted on. This proposed rule is a clear attempt by the Bush Administration to avoid litigation forcing the EPA to consult on pesticide impacts to species, and yet another chapter in the Bush Administration's litany of corporate protectionism.

River system in Montana

Unsurprisingly, the proposed rule and the new ESPP were strongly advocated for by the FIFRA Endangered Species Task Force (FESTF), a committee composed of fourteen agro-chemical companies. The EPA is shifting the focus of FESTF, originally formed to address data requirements, to making policy recommendations to weaken the ESA. Through FESTF the EPA has provided for the agro-chemical industry to lobby behind closed doors as an "advisory committee" for weaker ESA protections. Meanwhile, the public is left to participate in a rulemaking process dominated by a heavily financed agro-chemical and farm grower lobbying effort which already has close contact with the rule makers.

Photo courtesy of USFWS

Concerned about EPA's efforts to avoid compliance with the ESA through rule changes, 66 members of Congress recently sent a letter to the EPA, Secretary Norton and Secretary Evans, "expressing serious concern…."[187] The Representatives noted that the proposed regulation "unilaterally eliminates expert review of the scientific evidence that serves as an independent check and safeguard…[,] would allow flawed science to be the basis for determining whether and the extent to which endangered species must be protected from pesticides…[and] would give the chemical industry special participation rights that are not shared by the public or the workers who are exposed to these chemicals."[188] The letter concluded that "[t]hese proposed regulations are a step backward for both wildlife and farm worker protections."[189]

Pesticides are contaminating our air and water while the EPA fails to adequately regulate their use to protect our environment. The USGS has documented the widespread contamination of our nation's water-ways and aquatic species. Pesticides have been identified as one of the fifteen leading causes of impairment for streams on the Clean Water Act's section 303(d) list of impaired waters.[190]

Wetlands in Oregon

Amphibians are a barometer of environmental health - adverse impacts to amphibians are a sign that our ecosystems are under stress. The EPA's attempt to ignore the documented and disturbing impacts of pesticides to amphibians by dismissing the science will not alleviate this systemic problem. Additionally, these problems are not limited to wildlife. Neurological and sexual developmental dysfunctions also affect humans, and especially children.[191] A recent study found that women who were infertile were 27 times more likely to have mixed or applied herbicides in the two years prior to attempting conception than women who were fertile.[192] Farmers, manufacturers and applicators of pesticides have an increased risk of certain types of malignancies, especially lip, prostate, or testicular cancer, lymphoma, leukemia, brain tumors, pancreatic cancer, sarcoma and multiple myeloma.[193]

The EPA's 1997 *Special Report on Environmental Endocrine Disruption* notes that "possible human health endpoints" affected by endocrine-disrupting chemicals include breast cancer, endometriosis, testicular and prostate cancers, abnormal sexual development, reduced male fertility, neurobehavioral effects and immune system suppression.[194]

Photo courtesy of USFWS

The science is astounding: pesticides are in our waterways, groundwater, air, and soils. They are also being absorbed daily by plants, wildlife, and humans.The EPA, discouragingly, has shown more interest in assisting the agro-chemical industry than ensuring human and wildlife safety. In fact, much of the studies and data supporting the registration documents are compiled by the registrants themselves. The EPA often dismisses environmental concerns in the face of hard science, and steadfastly refuses to adopt any mandatory measures to limit pesticide use. This catering to the chemical industry must end if the EPA is truly concerned about protecting humans and wildlife from these toxins.

Also available is use of "beneficial" insects including predators and parasitoids such as lady beetles and various wasps, as well as certain nematodes that are used for insect control. Organic agriculture and less harmful alternatives to chemical pesticides such as organic pesticides and IPM are better in the long term for the health of farmers, farm workers, America's communities and wildlife.It is a testament to the success achieved by the environmental community that pesticide use has become such a hotly debated issue. However, there is much work to be done before the EPA actually functions as an environmental "protection" agency.

There are safe and effective alternatives to most of the harmful pesticides registered for use by the EPA. There are numerous effective organic pesticides such as botanicals, microbials, synthetics and minerals. A strategy known as Integrated Pest Management (IPM) relies upon information on the life cycles of pests and their interaction with the environment to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the envronment. IPM relies primarily on non-chemical means – such as controlling climate, food sources, and building entry points - to prevent and manage pest infestation. Chemical treatments are used only in a crisis situation threatening rapid losses or when pests fail to succumb to more conservative methods.

Gulf of Mexico Refuge

The EPA pesticide registration process is not adequately safeguarding human health and wildlife because the agro-chemical industry is allowed to control the process and the "science" of risk analysis. The environmental and public health communities must continue to apply pressure on the EPA to follow the laws created to protect humans and wildlife from these dangerous chemicals. The Bush administration proposal to allow the EPA to self-consult on the impacts of pesticides must be scrapped: with the undue influence of the agrochemical industry this policy is the equivalent of the fox guarding the henhouse. The EPA's pesticide registration program must be reformed to comply with the Endangered Species Act and prevent registration and use of harmful pesticides that are causing jeopardy to humans and wildlife.

Photo courtesy of USFWS

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