CENTER for BIOLOGICAL DIVERSITY

January 27, 2010

***Sent via Fed Ex and Email***

Lisa Jackson, Administrator
United States Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Mail Code: 1101A
Washington, DC 20460
jackson.lisap@epa.gov

Ken Salazar
Secretary of the Interior
1849 C Street, NW
Washington, DC 20240
exsec@ios.doi.gov

Gary Locke
Secretary of Commerce
U.S. Department of Commerce
1401 Constitution Avenue, N.W., Room 5516
Washington, D.C. 20230
TheSec@doc.gov

Sam Hamilton, Director
United States Fish and Wildlife Service
1849 C Street, NW
Washington, DC 20240
sam_hamilton@fws.gov

Dr. James W. Balsiger
Acting Assistant Administrator for Fisheries
National Oceanographic and Atmospheric Administration
1315 East-West Highway
Silver Spring, MD 20910
Jim.Balsiger@noaa.gov

**Re: Notice of Violations of the Endangered Species Act Related to the Registration of Pesticides**

On behalf of the Center for Biological Diversity, I hereby provide notice, pursuant to section 11(g) of the Endangered Species Act ("ESA"), 16 U.S.C. §1540(g)(2)(A)(i), that the Environmental Protection Agency ("EPA") is in violation of the ESA, 16 U.S.C. § 1521, *et seq*. Specifically, EPA has failed to satisfy its ESA Section 7 consultation requirements that apply to pesticide registrations and reregistrations.

Attached to this Notice of Intent to Sue ("NOI"), as Exhibit A, are charts identifying threatened and endangered species and the registered pesticides whose concentrations in the environment may exceed Levels of Concern ("LOCs") to those species and/or that are "highly" to "very highly" toxic to those species. The pesticides included in Chart 1 may exceed LOCs for mammals and/or are "highly" to "very highly" toxic to mammals and therefore "may affect" the endangered and threatened mammalian species listed in Chart 1. The pesticides included in Chart 2 may exceed LOCs for birds and/or are "highly" to "very highly" toxic to birds and therefore "may affect" the endangered and threatened avian species listed in Chart 2. The

Arizona • California • Nevada • New Mexico • Alaska • Oregon • Montana • Illinois • Minnesota • Vermont • Washington, DC

Justin Augustine • 351 California St., Suite 600 • San Francisco, CA 94104
Phone: 415-436-9682 x302 • Fax: 415-436-9683 • jaugustine@biologicaldiversity.org

pesticides included in Chart 3 may exceed LOCs for fish and/or are "highly" to "very highly" toxic to fish and therefore "may affect" the endangered and threatened fish species listed in Chart 3. The pesticides listed in Chart 4 may exceed LOCs for amphibians and/or are "highly" to "very highly" toxic to amphibians and therefore "may affect" the endangered and threatened amphibian species listed in Chart 4. The pesticides listed in Chart 5 may exceed LOCs for mollusks and/or are "highly" to "very highly" toxic to mollusks and therefore "may affect" the endangered and threatened mollusk species listed in Chart 5. The pesticides listed in Chart 6 may exceed LOCs for crustaceans and/or are "highly" to "very highly" toxic to crustaceans and therefore "may affect" the endangered and threatened crustacean species listed in Chart 6. The pesticides listed in Chart 7 may exceed LOCs for insects and/or are "highly" to "very highly" toxic to insects and therefore "may affect" the endangered and threatened insect species listed in Chart 7. The pesticides listed in Chart 8 may exceed LOCs for plants and/or are "highly" to "very highly" toxic to plants and therefore "may affect" the endangered and threatened plant species listed in Chart 8. The pesticides listed in Chart 9 may exceed LOCs for reptiles and/or are "highly" to "very highly" toxic to reptiles and therefore "may affect" the endangered and threatened reptile species listed in Chart 9. For each of these pesticides, EPA must conduct an effects determination and, if necessary, initiate consultation with the appropriate wildlife agency (FWS or NMFS).[1]

EPA is also in violation of Section 9 of the ESA for the take of listed species which is resultant from pesticide applications. Furthermore, EPA has failed to comply with sections 7(a)(1) and 2(c) of the ESA. Finally, EPA is in violation of the Migratory Bird Treaty Act due to the take of birds that is caused by registered pesticides.

## LEGAL BACKGROUND

### A. The Endangered Species Act

The Endangered Species Act ("ESA") was enacted, in part, to provide a "means whereby the ecosystems upon which endangered species and threatened species depend may be conserved . . . [and] a program for the conservation of such endangered species and threatened species . . . ."[2]

The ESA vests primary responsibility for administering and enforcing the statute with the Secretaries of Commerce and Interior. The Secretaries of Commerce and Interior have delegated this responsibility to the National Marine Fisheries Service ("NMFS") and the U.S. Fish and Wildlife Service ("FWS") respectively.[3]

[1] This NOI does not cover pesticide/species combinations for which effects determinations, and ESA section 7 consultations, are already in progress (or may soon be) as a result of a court order (e.g., Washington Toxics (salmonids), and Center for Biological Diversity (Barton Springs salamander, California red-legged frog, 11 Bay Area species)) However, to the extent that those effects determinations, and consultations, are geographically constrained, this NOI does address species/pesticides combinations for any geographic area not addressed by the effects derminations and consultations.

[2] 16 U.S.C. §§ 1531-1544; 16 U.S.C. § 1531(b)

[3] 50 C.F.R. § 402.01(b)

Section 2(c) of the ESA establishes that it is "the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."[4] The ESA defines "conservation" to mean "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."[5] Similarly, Section 7(a)(1) of the ESA directs that the Secretary review "…other programs administered by him and utilize such programs in furtherance of the purposes of the Act."[6]

In order to fulfill the substantive purposes of the ESA, federal agencies are required to engage in consultation with FWS (and/or NMFS) to "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 adverse modification of habitat of such species . . . determined . . . to be critical . . . ."[7]

Section 7 consultation is required for "any action [that] may affect listed species or critical habitat."[8] Agency "action" is defined in the ESA's implementing regulations to include "(b) the promulgation of regulations; (c) the granting of licenses, contracts, leases, easements, rights-of-way, permits, or grants-in-aid; or (d) actions directly or indirectly causing modifications to the land, water, or air."[9]

At the completion of consultation, FWS or NMFS issues a biological opinion that determines if the agency action is likely to jeopardize the species. If so, the opinion may specify reasonable and prudent alternatives that will avoid jeopardy and allow the agency to proceed with the action.[10] FWS and NMFS may also "suggest modifications" to the action during the course of consultation to "avoid the likelihood of adverse effects" to the listed species even when not necessary to avoid jeopardy.[11]

An agency's duty to avoid jeopardy is continuing, and "where discretionary Federal involvement or control over the action has been retained or is authorized by law," the agency must in certain circumstances reinitiate formal consultation:[12]

---

[4] 16 U.S.C. § 1531(c)(1)

[5] 16 U.S.C. § 1532(3)

[6] 16 U.S.C. § 1536(a)(1)

[7] 16 U.S.C. § 1536(a)(2) ("Section 7 consultation")

[8] 50 C.F.R. § 402.14

[9] 50 C.F.R. § 402.02

[10] 16 U.S.C. § 1536(b)

[11] 50 C.F.R. § 402.13

[12] 50 C.F.R. § 402.16

(a) If the amount or extent of taking specified in the incidental take statement is exceeded;
(b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
(c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or
(d) If a new species is listed or critical habitat designated that may be affected by the identified action.

Section 7(d) of the ESA, provides that once a federal agency initiates consultation on an action under the ESA, the agency, as well as any applicant for a federal permit, "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate subsection (a)(2) of this section."[13] The purpose of Section 7(d) is to maintain the environmental status quo pending the completion of consultation. Section 7(d) prohibitions remain in effect throughout the consultation period and until the federal agency has satisfied its obligations under Section 7(a)(2) that the action will not result in jeopardy to the species or adverse modification of its critical habitat.

## B. Relationship Between the Endangered Species Act and the Federal Insecticide, Fungicide, and Rodenticide Act

Congress enacted the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") to regulate the use of pesticides in the United States.[14] FIFRA charges the EPA with registering, reviewing, amending, and reregistering chemicals and chemical formulations for use as insecticides, fungicides, and pesticides in the United States.[15] Under FIFRA, a pesticide generally may not be sold or used in the United States unless it has an EPA registration for that particular use.[16] EPA may register a pesticide if it makes 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.[17] The culmination of the registration process is EPA's approval of a label for the particular pesticide. FIFRA makes it unlawful to use a pesticide in a manner inconsistent with the label,[18] or to make any claims that differ substantially from the label.[19]

---

[13] 16 U.S.C. § 1536(d)

[14] *See* 7 U.S.C. §§ 136-136y

[15] *Id*.

[16] 7 U.S.C. § 136a(a)

[17] 7 U.S.C. § 136a(c)(5)

[18] *Id*. at § 136j(2)(G)

EPA must classify pesticides as general or restricted use pesticides, depending on the risks posed to the environment. Where necessary to guard against unreasonable adverse environmental effects, EPA must classify a pesticide as restricted use.[20] Restricted use pesticides are subject to additional regulatory restrictions, particularly concerning application of the pesticide.[21] EPA must reclassify pesticides as restricted use pesticides where necessary to prevent unreasonable adverse effects on the environment.[22]

After approving a pesticide registration, EPA retains discretionary involvement and control over that registration. EPA must periodically review pesticide registrations with a goal of reviewing each pesticide registration every 15 years.[23] EPA has the authority to compel registrants to submit data necessary for a registration review.[24] Even apart from such explicit data submission requirements, registrants must submit to EPA any information about registered pesticides' unreasonable adverse effects on the environment.[25] EPA takes such information into account in reviewing and, where necessary, modifying the pesticide registrations.

The EPA Administrator has the authority to 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."[26] The Administrator may immediately suspend a pesticide registration to prevent an imminent hazard.[27] An announcement by the Administrator of an intent to cancel a pesticide use often results in the registrant's voluntary cancellation of, or agreement to further constraints upon that use.

The ESA's Section 7 requirements apply to EPA's registration of pesticides.[28] As discussed in *Wash. Toxics Coalition v. EPA*,[29]

---

[19] *Id*. at § 136j(1)(B)

[20] 7 U.S.C. § 136a(d)(1)(C)

[21] *Id*.

[22] *Id*. at § 136a(d)(1)(C)(2)

[23] *Id*. at § 136a(g)(1)

[24] *Id*. at § 136a(g)(2)

[25] *Id*. at § 136d(a)(2)

[26] *Id*. at § 136d(b)

[27] *Id*. § 136d(c)

[28] *Wash. Toxics Coalition v. EPA*, 413 F.3d 1024, 1032 (9th Cir. 2005) ("We agree with the Eighth Circuit that even though EPA registers pesticides under FIFRA, it must also comply with the ESA when threatened or endangered species are affected."); *Defenders of Wildlife v. Administration*, 882 F.2d 1294 (8th Cir. 1989) (affirming section 7's application to EPA's registration of pesticides)

[29] 413 F.3d at 1033

> EPA retains ongoing discretion to register pesticides, alter pesticide registrations, and cancel pesticide registrations. See 7 U.S.C. § 136a-d. Because EPA has continuing authority over pesticide regulation, it has a continuing obligation to follow the requirements of the ESA. We have respected such continuing obligations in well-reasoned authority that binds us here.
>
> In this case, EPA has similar discretion "to inure to the benefit" of listed species. Pesticide registrations under FIFRA are ongoing and have a long-lasting effect even after adoption. EPA retains discretion to alter the registration of pesticides for reasons that include environmental concerns. See 7 U.S.C. §§ 136d(c)(1)-(2), 136(l).

## FACTUAL BACKGROUND

EPA, FWS, NMFS, the National Park Service ("NPS"), the National Forest Service ("NFS"), and the U.S. Geological Survey ("USGS") have all acknowledged the impact of pesticides on our environment. Scientific researchers have also published numerous studies documenting the impact of registered pesticides on the environment. As discussed below, this information demonstrates that EPA has failed in its legal obligations to properly manage and implement the pesticide registration program, which in turn results in severe impacts upon our ecosystems.

### A. The Pervasiveness of Pesticides

Pesticides are well known to have adverse effects on wildlife species. These impacts have been in the public consciousness since the mid-1950s when author and activist Rachel Carlson published *Silent Spring*.[30] Her book examined the impacts of DDT on birds. While DDT has now been banned, similar compounds, known as organophosphorus pesticides are still being used. Sparling and Fellers (2007)[31] discuss the impacts of these pesticides on the environment:

> Organophosphorus (OPs) pesticides have long been of serious environmental concern. They form the largest group of chemicals used in the control of pests including invertebrates, vertebrates and, to a lesser extent, plants. There are some 200 OP pesticides available in this class that have been formulated into literally thousands of different products. These products are used in agriculture, forests, gardens, home and industrial sites, urban and rural areas. As one example, over 3.0 million kg of active ingredient OPs were used in California during 2004, the most recent reporting year (California Department of Pest Regulation, 2006). It is estimated that this accounts for about 25% of OP use nationwide.

---

[30] Carlson, Rachel. *Silent Spring*. Boston: Houghton Mifflin, 1962

[31] Sparling D.W. and G. Fellers. 2007. Comparative toxicity of chlorpyrifos, diazinon, malathion and their oxon derivatives to larval *Rana boylii*. *Environmental Pollution* 147:535-539

> Organophosphorus pesticides function to inhibit cholinesterase. They bind with acetylcholinesterase, an enzyme that breaks down the neurotransmitter acetylcholine so that subsequent impulses can be transmitted across the synapse. Therefore, inhibiting acetylcholinesterase results in repeated, uncontrolled firing of neurons leading to death usually by asphyxiation as respiratory control is lost.

Organophosphorus pesticides are just the tip of the iceberg when it comes to pesticide use in the United States. Over 1 billion pounds of pesticides are used each year in this country to control weeds, insects and other organisms.[32] The USGS's 2006 Report (updated in 2007) regarding pesticides in U.S. waters, found that

> At least one pesticide was detected in water from all streams studied and … pesticide compounds were detected throughout most of the year in water from streams with agricultural (97 percent of the time), urban (97 percent), or mixed-land-use watersheds (94 percent). In addition, organochlorine pesticides (such as DDT) and their degradates and by-products were found in fish and bed-sediment samples from most streams in agricultural, urban, and mixed-land-use watersheds—and in more than half the fish from streams with predominantly undeveloped watersheds. Most of the organochlorine pesticides have not been used in the United States since before the NAWQA studies began, but their continued presence demonstrates their persistence in the environment.[33]

The USGS Report's lead author, Robert J. Gilliom, in a presentation entitled "Pesticides in the Nation's Water Resources," stated 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."[34] This is a striking statement and one that should raise significant concern about the effects of pesticides on wildlife species.

While aquatic species can be significantly harmed as a result of the pesticide use, many other terrestrial species may also be adversely affected. For instance, rodenticides are known to be a major cause in the decline of terrestrial species like the endangered San Joaquin kit fox. In a 2005 letter from the FWS to EPA, FWS noted that:[35]

> continued use of rodenticides under current conditions presents a significant level of risk to birds and nontarget mammals . . . . Secondary exposure to brodifacoum has been implicated in mortality events involving the following: several species of

---

[32] Gilliom RJ, Barbash JE, Crawford CG, Hamilton PA, Martin JD, Nakagaki N, Nowell LH, Scott JC, Stackelberg PE, Thelin GP, Wolock DM. 2007. The quality of our nation's waters—pesticides in the nation's streams and ground water, 1992–2001. US Geological Survey circular 1291 ("USGS 2007")

[33] USGS Fact Sheet 2006–3028, Pesticides in the Nation's Streams and Ground Water, 1992–2001—A Summary

[34] USGS Pesticide National Synthesis Project, 1999, Pesticides in the Nation's Water Resources—Water Environment Federation Briefing Series, March 19, 1999, Capitol Building, Washington, D.C.

[35] February 28, 2005 Letter from Everett Wilson (USFWS) to Kelly White (EPA)

owls, hawks, and vultures; bald and golden eagles; corvids, coyotes, bobcats, and mountain lions; raccoons, the long-tailed weasel, striped skunk, opossum, red and gray foxes; and the Federally endangered San Joaquin kit fox (26 documented kit fox mortalities between 1999 and 2002). Though restricted to use in or around buildings, this pesticide clearly finds its way into the natural food chain.

An EPA May 2008 Risk Assessment further explains:[36]

> Incident reports have identified many taxa of non-target animals exposed to rodenticides, including strict carnivores such as mountain lions, bobcats, hawks and owls; omnivores such as coyotes, foxes, skunks and raccoons; and granivores and herbivores such as squirrels and deer. EPA's updated rodenticide ecological incident report documents anticoagulant residues in 27 avian species and 17 mammalian species. For some species (e.g. bobcats, foxes, great horned owls), carcasses frequently contain residue of two or more anticoagulants, usually second generation compounds. In approximately 50% of those incidents, necropsy results indicate that it is highly probable that a second-generation anticoagulant was the cause of the death. The frequency with which second-generation anticoagulants are found is highly significant. EPA believes that widespread exposures to second-generation anticoagulants are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide.

Ten years ago, the Pesticide Action Network North America ("PANNA") released a report, *Disrupting the Balance: Ecological Impacts of Pesticides in California*, which documented the impact of organophosphate and carbamate pesticides on wildlife.[37] The report found that multiple pesticides are often found in California waters and sediments at concentrations that exceed levels that are 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 documented that carbofuran and diazinon are responsible for the majority of bird kills in California, affecting songbirds, waterfowl, and raptors. The report noted that the application of carbofuran to crops resulted in as many as 17 bird kills for every 5 acres treated. The report also documented the adverse impact pesticides have on the balance between pest and predator insects, where

[36] U.S. EPA, Risk Mitigation Decision for Ten Rodenticides (June 24, 2008)

[37] Kegley, S, L. Neumeister, and T. Martin, Disrupting the Balance: Ecological Impacts of Pesticides in California, available at http://www.panna.org/files/disruptingAvail.dv.html

pesticides destroy nontarget predator insects, which in turn allows for a resurgence in the pest insects.

These findings represent just a few of the examples of the harm being inflicted by widespread pesticide use. These problems have been known for years now and yet continue to be neglected at the expense of numerous species and their habitat. Action by EPA to ensure that registered pesticides are not jeopardizing the survival and recovery of endangered and threatened species is long overdue.[38]

### B. Pesticide Fate

Once a pesticide is introduced into the environment it may be influenced by a variety of processes which affect the pesticide's persistence and movement (referred to as a pesticide's "fate") in the environment. Of particular concern is the movement of pesticides in our Nation's waters due to the significant exposure it causes to nontarget organisms. There are three major fate processes which must be taken into consideration when determining the impact of a pesticide on the environment: (1) adsorption – the binding of pesticides to mineral or soil particles; (2) transfer – the movement of pesticides in the environment; and (3) degradation – the breakdown of pesticides over time.

Adsorption is relevant because the tendency of pesticides to bind to soil particles varies, influencing the ability of a particular pesticide to enter into other biological or chemical pathways.[39] Both pesticide runoff and pesticide drift can be highly influenced by whether a pesticide adsorbs to soil or dust particles that travel in the environment.

Pesticide transfer can occur through volatilization, runoff, leaching, drift, absorption, and physical removal. Water is one of the primary pathways by which pesticides are transported from their application areas to other parts of the environment. Runoff is of particular concern. Movement of pesticides via runoff can occur whether pesticides are dissolved in the water or bound to eroding soil particles.[40] Pesticides which are carried into surface waters via runoff can directly and indirectly harm aquatic organisms. On land, nontarget species (such as owls, vultures, and foxes) can be adversely affected when they consume target species (such as mice and rats) that contain a pesticide, or when they consume the bait/pesticide itself. When determining the likelihood of harm to nontarget organisms, the cumulative effect of pesticide fate and transport must be considered to address the impact of pesticides on endangered and threatened species.

---

[38] Even producers of chemicals recognize that effects determinations are long overdue. Allen James, president of RISE, or Responsible Industry for a Sound Environment, has stated, "We have always supported full implementation of the law. We want [EPA] to do it, we need them to do it as rapidly, as scientifically, as possible."

[39] Harrison, S.A., The Fate of Pesticides in the Environment, Agrichemical Factsheet #8, Penn State Cooperative Extension, 1990

[40] *Id*.

Pesticides can also break down into what are referred to as degradates. In fact, pesticide degradation products are often detected more frequently than parent compounds and concentrations of pesticide degradates often exceed concentrations of parent compounds. These breakdown products are different from the parent product and can have adverse impacts of their own.

### C. Pesticide Transport

Aerial pesticide applications can result in subtantial amounts of pesticides drifting offsite.[41] Pesticide drift is defined as any airborne movement of pesticides off the target site.[42] Spray drift occurs during and soon after a pesticide application, while post-application drift occurs after the application is complete. During pesticide applications, winds or application equipment can blow spray droplets and vapors from mid-air droplet evaporation (with liquid applications) or particles (with dust applications) off site. Fine droplets generated by spray nozzles are the most problematic and can drift long distances before settling. Applications of gaseous fumigant pesticides always involve escape of the gases from the intended application site, generally through the normal (and presently legal) application process, but also through leaking equipment, containers, or tarps.

Pesticide drift does not end when applications are complete.[43] Post-application drift also may occur over many days and even weeks after a pesticide application. Post-application drift takes two forms. Volatilization drift is the first and occurs because some pesticides readily volatilize from the leaf and soil surfaces on which they were initially deposited. They might be liquids or oils when applied, but evaporate in the heat of the day, drift for a distance, and re-condense when the temperature drops or when they contact a cool surface, just like water vapor condenses on a glass of iced tea on a humid day. This process is repeated many times as the pesticide is carried by prevailing winds. Drift of pesticide-coated dust particles can also occur. High winds in agricultural areas create clouds of dust from pesticide-treated fields. This dust is eventually deposited. Both volatile and non-volatile pesticides may cling to dust particles and drift in this manner.

The amount of drift that occurs via pesticide use has been characterized as "considerable" by the National Research Council and is thought to vary from 5% (under optimal low wind conditions) to 60% (under more typical conditions).[44] The Office of Technology Assessment estimates that about 40% of an aerial insecticide application leaves the target area and that less than 1%

---

[41] Cox, C. 1995. Pesticide Drift-Indiscriminately from the Skies, *Journal of Pesticide Reform*, Vol.15, No.1

[42] Kegley, Susan, Anne Katten, and Marion Moses. 2003. Secondhand Pesticides Airborne Pesticide Drift in California. (One in a series of reports by Californians for Pesticide Reform)

[43] *Id*.

[44] National Research Council, Board on Agriculture, Committee on Long-Range Soil and Water Conservation, 1993, Soil and water quality: An agenda for agriculture, Washington, D.C., Natl. Academy Press, 323-324

actually reaches the target pest.[45] The typical range for drift is 100 meters to 1600 meters.[46] However, longer ranges have been documented (as a result of both drift and volatilization). For example, pesticide transport from orchard applications in Vermont exceeded 2 miles.[47] Pesticides applied to wheat fields in Colorado moved between 5 and 10 miles.[48] Applications in California were found 4 miles from an oat field.[49] And pesticide transport has been noted 10 to 50 miles from applications in central Washington.[50]

Impacts to wildlife from pesticide transport are well documented. In a study done by the USGS, pesticide transport from the Central Valley of California was found to impact frog species in the Sierra Nevada mountain range.[51] The study found that the most drastic population declines of several frog species (red-legged frog, *Rana aurora*, yellow-legged frog, *Rana boylii*, mountain yellow-legged frog, *Rana muscosa*, and Yosemite toad, *Bufo canorus*) are found in the Sierra Nevadas, downwind from the San Joaquin Valley. In 1998, over 60% of the total pesticide usage in the state of California was sprayed in the San Joaquin Valley. The study found a close correlation between the declining populations of frogs and exposure to agricultural pesticides. Particularly, the study found diazinon, endosulfan, and chlorpyrifos at toxic levels in over half the frogs tested. Another study found that organochlorines enter far away sites via precipitation or dry deposition, and that they readily accumulate in *R. muscosa* tissue.[52]

*Declining Downwind: Amphibian Population Declines In California And Historical Pesticide Use*,[53] further confirms the significant pesticide transport that is occurring in California. The study found "a strong association between amphibian declines and total upwind pesticide use for . . . four ranid frogs." And similarly, the publication, *Spatial Tests of the Pesticide Drift, Habitat*

---

[45] U.S. Congress, Office of Technology Assessment, 1990, Beneath the bottom line: Agricultural approaches to reduce agrichemical contamination of groundwater, Report No. OTA-4-418, Washington, D.C., U.S. GPO

[46] Cox, C. 1995. Pesticide Drift-Indiscriminately from the Skies, *Journal of Pesticide Reform*, Vol.15, No.1

[47] *Id.*

[48] *Id.*

[49] *Id.*

[50] *Id.*

[51] Sparling, D.W., G.M. Fellers, and L.L. McConnell. 2001. Pesticides and Amphibian Population Declines in California. *Environmental Toxicology and Chemistry* 20(7):1591-1595; *see also* Lenoir, J.S., et al. 1999. Summertime transport of current-use pesticides from California's Central Valley to the Sierra Nevada Mountain Range. *Environmental Toxicology and Chemistry* 18(12):2715-2722

[52] Fellers, G. M., L. L. McConnell, D. Pratt, and S. Datta. 2004. Pesticides in mountain yellow-legged frogs (*Rana muscosa*) from the Sierra Nevada mountains of California, USA. *Environmental Toxicology and Chemistry* 23(9):2170-2177

[53] Davidson, Carlos. 2004. Declining Downwind: Amphibian Population Declines In California And Historical Pesticide Use. *Ecological Applications* 14(6), pp. 1892–1902

*Destruction, UV-B, and Climate-Change Hypotheses for California Amphibian Declines*,[54] determined that "the association of declines with the amount of upwind agricultural land use was striking for five of the six species for which habitat alteration was not a clear factor . . . . Additional evidence for the importance of upwind agriculture . . . comes from the categorical variable analysis, which demonstrated clear trends of increasing declines with increasing amounts of upwind agriculture. Of the factors we were able to examine, upwind agriculture was the strongest single factor explaining California declines for amphibian taxa in which declines were not driven primarily by overt habitat destruction."

More recent studies tell a similar story. Spalding and Fellers (2009) looked at the effects of two insecticides, chlorpyrifos and endosulfan, on the common pacific tree frog (*P. regilla*) and the endangered foothills yellow legged frog (*R. boylii*).[55] They note that:

> Evidence is growing that insecticides are having negative effects on amphibian populations in the Sierra Nevada Mountains of California. The San Joaquin Valley, an intensely agricultural region, lies upwind of the more pristine montane habitats where amphibians are disappearing. Thousands of kg of active ingredient pesticides are sprayed on crops in this region annually. The most commonly used insecticides include the organochlorine endosulfan and cholinesterase-inhibiting organophosphorus insecticides such as chlorpyrifos, diazinon, and malathion.[56]
>
> These insecticides are found in air, snow, and surface waters of National Parks and other sites in the Sierra Nevada Mountains. They have also been detected in amphibian tissues. Whereas acute toxicity data exist for a few of these insecticides, the effects of long term or chronic exposure are less well known. Pesticides can have many adverse effects on amphibians including decreased growth and developmental rates, increased incidence of external abnormalities, impaired reproductive potential, and death. They can also interact with other factors to alter mortality.

The results of Spalding and Fellers' research shows that both chlorpyrifos and endosulfan are highly toxic to *P. regilla* and *R. boylii* and that *R. boylii* is more sensitive to these insecticides than is *P. regilla.* For chlorpyrifos, the median lethal concentrations were in the few hundreds of a part per billion range, and the estimated LC50 for *P. regilla* was approximately five times

---

[54] Davidson, Carlos, H. Bradley Shaffer, and Mark R. Jennings. 2002. Spatial Tests of the Pesticide Drift, Habitat Destruction, UV-B, and Climate-Change Hypotheses for California Amphibian Declines. *Conservation Biology* 16:6, pg. 1588–1601

[55] Sparling, Donald W. and Gary M. Fellers. 2009. Toxicity of two insecticides to California anurans and its relevance to declining amphibian populations. *Environmental Toxicology* 28(8):1696-703

[56] California Pesticide Information Portal. http://www.cdpr.ca.gov/docs/pur/purmain.htm

greater than that for *R. boylii*.[57] However, endosulfan was considerably more toxic than chlorpyrifos in both species, with the estimated LC50s in the few or sub parts per billion range. Endosulfan was 21 times more toxic than chlorpyrifos in *P. regilla* and nearly 121 times greater in *R. boylii.* Thus, environmental concentrations of insecticides from pesticide drift in the Sierra Nevada Mountains of California have the potential to inflict serious damage on native amphibians.

Current-use and historic-use pesticides are also showing up in seasonal snowpacks in high-elevation and high-latitude national parks via atmospheric transport.[58] The most frequently detected current-use pesticides were dacthal, chlorpyrifos, endosulfan, and ç-hexachlorocyclohexane.[59] This is cause for serious concern as it demonstrates that no place on Earth is safe from pesticide impacts.

The EPA must incorporate the transport of pesticides when assessing pesticide impacts on listed species.

### D. Pesticide Presence in U.S. Waters

The USGS's 2007 Report provides extensive data regarding the presence of pesticides in U.S. waters.[60] The Report's findings indicate that streams and groundwater in watersheds with significant agricultural or urban development, or with a mix of these land uses, almost always contain mixtures pesticides.[61] At least one pesticide was found in nearly every water and fish sample collected.[62] Moreover, individual pesticides seldom occurred alone; almost every sample from streams contained two or more pesticides.[63] The USGS Report also notes a direct correlation between the amounts of pesticides used and the frequency of pesticides found in surface waters.[64] The USGS data likely underestimates the scope and magnitude of pesticide pollution of surface waters – the USGS evaluated the concentrations of only about 90 of the highest use pesticides; approximately 1,000 registered pesticide active ingredients are in use.

---

[57] *P. regilla* populations seem to be stable or declining at a slower rate. A possible cause of their relative success is their reduced dependence on standing water. *P. regilla* adults lay their eggs in water and move to upland habitat shortly afterwards; hatching is rapid compared to some of the other species; and time to metamorphosis is less than that of *R. boylii*

[58] Hageman, K. J., S. L. Simonich, D. H. Campbell, G. R. Wilson, and D. H. Landers. 2006. Atmospheric deposition of current-use and historic-use pesticides in snow at national parks in the western United States. *Environmental Science & Technology* 40(10):3174-3180

[59] *Id*.

[60] USGS 2007 Report

[61] *Id*.

[62] *Id*.

[63] *Id*.

[64] *Id*.

One stark example of the problem is atrazine, the most commonly detected pesticide in U.S. waters.[65] Between 60 and 80 million pounds of atrazine, which is already banned in the European Union, is applied in the U.S., and about 75% of streamwater and 40% of groundwater contains atrazine.[66] The report found that watersheds are pervasively contaminated with atrazine – twenty-five watersheds had average concentrations above 1 ppb. At 1 ppb, the primary production of aquatic non-vascular plants is reduced, at 0.1 ppb, atrazine can alter the development of sex characteristics in male frogs. Of the watersheds sampled, nine had samples of 50 ppb or above, and four exceeded 100 ppb. This report is a wake-up call to the fact that for far too long, EPA has erred heavily on behalf of industry to the detriment of our environment.

The USGS Report also addresses pesticide presence in stream sediment as well as fish tissue:

> Concentrations of organochlorine pesticide compounds measured in bed sediment were greater than one or more aquatic-life benchmarks at 70 percent of urban stream sites, 31 percent of agricultural sites, 36 percent of sites with mixed land use, and 8 percent of undeveloped sites. The geographic distribution of sites where aquatic-life benchmarks for bed sediment were exceeded is similar to findings for water in many respects, including urban streams throughout the country, and many agricultural and mixed-land-use streams in the Southeast, East, and irrigated areas of the West. In urban streams, aquatic-life benchmarks were most frequently exceeded by individual compounds in the DDT group or total DDT (58 percent of sites), total chlordane (57 percent), and dieldrin (26 percent).
>
> Comparisons of concentrations of organochlorine pesticide compounds measured in whole fish with benchmarks for fish-eating wildlife indicate a wide range of potential for effects, depending on the type of wildlife benchmark used. Because there is no consensus on tissue-based benchmark values for wildlife, measured concentrations were compared with both the high and low benchmark values from the range available for each compound. The high benchmark values for fish tissue were exceeded most frequently in streams in the populous Northeast; in high-use agricultural areas in the upper and lower Mississippi River Basin; in high-use irrigated agricultural areas, such as eastern Washington and the Central Valley of California; and in urban streams distributed throughout the country.[67]

Many of the pesticides detected in sediment and/or biota have been discontinued for many years (most uses of organochlorine pesticides were discontinued years ago). Their continued presence[68] in sediment and biota, and the fact that their quantities still exceeded benchmarks for

---

[65] Wu, Mae, M. Quirindongo, J. Sass, and A. Wetzler. 2009. Atrazine: Poisoning the Well: How the EPA is Ignoring Atrazine Contamination in the Central United States, available at http://www.nrdc.org/health/atrazine/default.asp

[66] *Id*.

[67] USGS 2007 Report

[68] Given the long lasting presence of discontinued pesticides, EPA must consider the impacts of registered pesticides on endangered species in combination discontinued pesticides.

aquatic life and fish-eating wildlife in bed sediment or fish-tissue samples from many streams, raises serious concerns about the long-term chronic impacts of pesticides on listed species. Moreover, more recent and currently used pesticides, such as chlorpyrifos, benfluralin, dichlone, dicofol, bensulide, PCNB, endosulfan, dacthal, pentachlorophenol, esfenvalerate, ethalfluralin, fenthion, oxadiazo, fenvalerate, pendimethalin, lindane, triallate, methoxychlor, trifluralin, permethrin, phorate, and propargite, are all predicted to have potential to accumulate in sediment and aquatic biota.[69]

Also alarming is the USGS Report's finding that "concentrations of pesticides were frequently greater than water-quality benchmarks for aquatic life and fish-eating wildlife":[70]

> Of 186 stream sites sampled nationwide by the USGS, 57 percent of 83 agricultural streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year; 83 percent of 30 urban streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year; 42 percent of 65 mixed-land-use streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year.
>
> In urban streams, most concentrations greater than a benchmark involved the insecticides diazinon (73 percent of sites), chlorpyrifos (37 percent), and malathion (30 percent). In agricultural streams, most concentrations greater than a benchmark involved chlorpyrifos (21 percent of sites), azinphos-methyl (19 percent), atrazine (18 percent), *p,p'*-DDE (16 percent), and alachlor (15 percent).
>
> The pesticides detected most frequently in stream water included: (1) five agricultural herbicides that were among the most heavily used during the study period—atrazine (and its degradate deethylatrazine), metolachlor, cyanazine, alachlor, and acetochlor; (2) five herbicides extensively used for nonagricultural purposes, particularly in urban areas—simazine, prometon, tebuthiuron, 2,4-D, and diuron; and (3) three of the most extensively used insecticides during the study period—diazinon, chlorpyrifos, and carbaryl (fig. 1–4). Simazine, prometon, diuron, 2,4-D, diazinon, and carbaryl, which are commonly used to control weeds, insects, and other pests in urban areas, were frequently found at relatively high levels in urban streams throughout the Nation. [71]

The widespread presence of pesticides in our waterways demonstrates that wildlife, especially endangered and threatened aquatic wildlife or wildlife dependent upon aquatic species, is likely being adversely affected by pesticides. It is therefore imperative that the EPA immediately begin

---

[69] USGS Fact Sheet 092-00, Pesticides in Stream Sediment and Aquatic Biota

[70] USGS 2007 Report

[71] *Id*.

effects determinations for all ESA listed species that may be affected by pesticides found in U.S. waterways.

## E. Degradates

The USGS Report is also important for the light it sheds on pesticide degradates, which can be found more frequently and at higher concentrations than their parent pesticide. For instance, atrazine, the most heavily used herbicide in the U.S. during the USGS study period, was found together with one of its several degradates, deethylatrazine, in about 75 percent of stream samples and about 40 percent of ground-water samples collected in agricultural areas across the Nation.[72] Research by Sparling and Harvey (2006)[73] further details the extent of degradates. The study compared the effects of two chemicals, aqueous ammonium and perchlorate, on leopard frogs (*Rana pipiens*). Ammonium perchlorate is used as an oxidizer for rocket fuel, fire works, and other chemical processes. As it dissolves, it forms two ions—aqueous ammonium ($NH_4^+$) and perchlorate ($ClO_4^-$). Previous studies described the deleterious effects of perchlorate, but ignored effects of aqueous ammonium. The Sparling and Harvey study generated dose-response curves for mortality rates in leopard frogs at different doses. They found that the mortality of the frogs is due almost entirely to the ammonium ion, not the perchlorate ion. Furthermore, exposure to the two chemicals also caused sublethal effects, including loss of motor function in tadpoles and reduced growth. This study demonstrates the importance of considering the impacts of all breakdown products as well as the potential for sublethal impacts of breakdown products.

Another study, which investigated hormone disruption in amphibians, determined that the breakdown products of methoprene interfered with the retinoid hormone system.[74] Lab experiments with the toad, *Xenopus laevis*, suggest that S-methoprene (a commonly used pesticide in the U.S.) itself poses little risks to toads at commonly encountered levels in the environment. However, when the toad is exposed to methoprene's breakdown products, the exposure results in dramatic interference with normal amphibian development. This research confirms that studies of pesticide impacts must be carried out in ways that reflect real world interactions. Serious harmful effects were only evident once the experiment focused on the breakdown products of the active ingredient – a concern EPA acknowledges that they have not adequately addressed as all EPA REDs focus on the parent compound without investigation into the deleterious impacts of breakdown products.

In light of the widespread presence of degradates in U.S. waters, and the potential for serious impacts from degradates to threatened and endangered biota, EPA must incorporate pesticide degradate analyses into its ESA effects determinations. In the absence of such analysis, EPA's

---

[72] USGS 2007 Report

[73] Sparling, D. W. and G. Harvey. 2006. Comparative Toxicity of Ammonium and Perchlorate to Amphibians. *Bull. Environ. Contam. Toxicol.*, 76(2):210–217

[74] La Clair, J.J., J.A. Bantle and J. Dumont. 1998. Photoproducts and metabolites of a common insect growth regulator produce developmental deformities in *Xenopus*. *Environmental Science and Technology*, 32: 1453-1461

determinations will be inadequate to ensure that listed species are not being jeopardized by pesticide use.

## F. Endocrine Disruption

Endocrine disruptors are chemicals that mimic an organism's 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.[75] Endocrine disruption affects how an organism develops and functions. Reproductive disorders, immune system dysfunction, thyroid disorders, types of cancer, birth defects and neurological effects have all been linked to endocrine disruption. As discussed in a 1999 Report, over 60% of the poundage of all agricultural herbicides applied in the United States has the potential to disrupt endocrine and/or reproductive systems of humans and wildlife.[76] More than ten years ago, experts from a wide variety of disciplines were convened to jointly review evidence and assess hazards of endocrine disruption.[77] The group of scientists reached the following consensus statements:

1. *We are 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. This loss of potential in humans and wildlife is expressed as behavioral and physical abnormalities. It may be expressed as reduced intellectual capacity and social adaptability, as impaired responsiveness to environmental demands, or in a variety of other functional guises. Widespread loss of this nature can change the character of human societies or destabilize wildlife populations. Because profound economic and social consequences emerge from small shifts in functional potential at the population level, it is imperative to monitor levels of contaminants in humans, animals, and the environment that are associated with disruption of the nervous and endocrine systems and reduce their production and release.

- Because the endocrine system is sensitive to perturbation, it is a likely target for disturbance. In contrast to natural hormones found in animals and plants, some of the components and by-products of many manufactured organic compounds that interfere with the endocrine system are persistent and undergo

[75] *See generally* Gwynne Lyons, Effects of Pollutants on the Reproductive Health of Male Vertebrate Wildlife-Males Under Threat, CHEM Trust, 2008

[76] Short, P. and Colborn, T. 1999. Pesticide Use in the U.S. and Policy Implications: A Focus on Herbicides. *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 240-275

[77] Colborn T, Vom Saal F, Short, P, eds. 1998. Environment Endocrine-Disrupting Chemicals: Neural, Endocrine, and Behavioral Effects, Princeton, N.J.: Princeton Scientific Publishing, 1-9

biomagnification in the food web, which makes them of greater concern as endocrine disruptors.

- Man-made endocrine-disrupting chemicals range across all continents and oceans. They are found in native populations from the Arctic to the tropics, and, because of their persistence in the body, can be passed from generation to generation. The seriousness of the problem is exacerbated by the extremely low levels of hormones produced naturally by the endocrine system which are 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 which are biologically active.

- Gestational exposure to persistent man-made chemicals reflects the lifetime of exposure of females before they become pregnant. Hence, the transfer of contaminants to the developing embryo and fetus during pregnancy and to the newborn during lactation is not simply a function of recent maternal exposure. For some egg laying species, the body-burden of the females just prior to ovulation is the most critical period. For mammals, exposure to endocrine disruptors occurs during all of prenatal and early postnatal development because they are stored in the mother.

- The developing brain exhibits specific and often narrow windows during which exposure to endocrine disruptors can produce permanent changes in its structure and function. The timing of exposure is crucial during early developmental stages, particularly during fetal development when a fixed sequence of structural change is occurring and before protective mechanisms have developed. 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 an adult.

- 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. The eventual results of moderate to severe alterations of thyroid hormone concentrations, particularly during fetal life, are motor dysfunction of varying severity including cerebral palsy, mental retardation, learning disability, attention deficit hyperactivity disorder, hydrocephalus, seizures and other permanent neurological abnormalities. 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.

- Sexual development of the brain is under the influence of estrogenic (female) and androgenic (male) hormones. Not all endocrine disruptors are estrogenic or anti-estrogenic. For example, new data reveal that DDE, a breakdown product of DDT, found in almost all living tissue, is an anti-androgen in mammals. Man-made chemicals that interfere with sex hormones have the potential to disturb normal brain 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 exposure to sewage and industrial effluents, pesticides, ambient ocean and freshwater contamination, and the aquatic food web.

- 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. Most important, the same man-made chemicals that have shown these effects in mechanistic studies in laboratory animals also have a high exposure potential for humans.

- The full range of substances interfering with natural endocrine modulation of neural and behavioral development cannot be entirely defined at present. However, compounds shown to have endocrine effects include dioxins, PCBs, phenolics, phthalates, and many pesticides. Any compounds mimicking or antagonizing actions of, or altering levels of, neurotransmitters, hormones, and growth factors in the developing brain are potentially in this group.

2. *We estimate with confidence that:*

   - 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, simple (monotonic) dose-response curves for toxicity do not necessarily apply to the effects of endocrine disruptors.

   - Many pesticides affect thyroid function and, therefore, may have [neurological abnormalities].

   - Some endocrine disruptors or their break-down products are nearly equipotent to natural hormones. Even weak endocrine disruptors may exert potent effects because they can bypass the natural protection of blood binding proteins for endogenous hormones. Some disruptors also have a substantially longer biological half-life than naturally produced hormones because they are not readily metabolized, and as a result are stored in the body and accumulate to concentrations of concern.

A June 2009 Report from the Endocrine Society further explains and indicates that the problem has intensified:[78]

> Our understanding of the mechanisms by which endocrine disruptors exert their effect has grown. Endocrine disrupting chemicals (EDCs) were originally thought to exert actions primarily through nuclear hormone receptors, including estrogen receptors (ERs), androgen receptors (ARs), progesterone receptors, thyroid receptors (TRs), and retinoid receptors, among others. Today, basic scientific research shows that the mechanisms are much broader than originally recognized. Thus, endocrine disruptors act via nuclear receptors, nonnuclear steroid hormone receptors (*e.g.*, membrane ERs), nonsteroid receptors (*e.g.*, neurotransmitter receptors such as the serotonin receptor, dopamine receptor, norepinephrine receptor), orphan receptors [*e.g.*, aryl hydrocarbon receptor (AhR)—an orphan receptor], enzymatic pathways involved in steroid biosynthesis and/or metabolism, and numerous other mechanisms that converge upon endocrine and reproductive systems. Thus, from a physiological perspective, an endocrine-disrupting substance is a compound, either natural or synthetic, which, through environmental or inappropriate developmental exposures, alters the hormonal and homeostatic systems that enable the organism to communicate with and respond to its environment.
>
> The group of molecules identified as endocrine disruptors is highly heterogeneous and includes . . . pesticides [methoxychlor, chlorpyrifos, dichlorodiphenyltrichloroethane (DDT)], fungicides (vinclozolin) . . . .
>
> Some EDCs were designed to have long half-lives; this was beneficial for their industrial use, but it has turned out to be quite detrimental to wildlife and humans. Because these substances do not decay easily, they may not be metabolized, or they may be metabolized or broken down into more toxic compounds than the parent molecule; even substances that were banned decades ago remain in high levels in the environment, and they can be detected as part of the body burden of virtually every tested individual animal or human. In fact, some endocrine disruptors are detectable in so-called "pristine" environments at remote distances from the site they were produced, used, or released due to water and air currents and via migratory animals that spend part of their life in a contaminated area, to become incorporated into the food chain in an otherwise uncontaminated region.

The Endocrine Society Report also makes clear that pesticides are a significant part of the problem:

---

[78] Diamanti-Kandarakis, Evanthia , Jean-Pierre Bourguignon, Linda C. Giudice, Russ Hauser, Gail S. Prins, Ana M. Soto, R. Thomas Zoeller, and Andrea C. Gore. 2009. Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement. *Endocrine Reviews* 30(4):293–342

> Evaluation of more than 55,000 pesticide applicators revealed a direct link between increased prostate cancer rates and exposure to methyl bromide, a fungicide with unknown mechanism of action (236). In addition, six pesticides (of 45 common agricultural pesticides) showed significant correlation with exposure and increased prostate cancer rates in men with a familial history of the disease, suggesting gene-environment interactions. These six agents were chlorpyrifos, fonofos, coumaphos, phorate, permethrin, and butylate (236, 238). The first four compounds are thiophosphates that share a common chemical structure.
>
> Nonpersistent pesticides (also referred to as "contemporary- use pesticides") are chemical mixtures that are currently available for application to control insects (insecticides), weeds (herbicides), fungi (fungicides) or other pests (*e.g*., rodenticides), as opposed to pesticides that have been banned from use in most countries (*e.g*., many of the formerly popular organochlorine pesticides such as DDT). Three common classes of nonpersistent pesticides in use today include organophosphates, carbamates, and pyrethroids. Although environmentally nonpersistent, the extensive use of pest control in these various settings results in a majority of the general population being exposed to some of the more widely used pesticides at low levels.

Endocrine disruptors were a major aspect of the 2007 USGS Report which notes how "more than 50 synthetic chemical compounds, including a number of pesticides, have been identified as potential endocrine disruptors in various studies over the past several years (National Academy of Sciences, 1999)."[79] The USGS Report cites a number of studies including the "feminization of gull embryos linked to elevated DDT (Fry and Toone, 1981), population declines of alligators in some Florida Lakes with elevated concentrations of organochlorine pesticides (including DDT) (Guillette and others, 1994), and feminization of fish in water bodies receiving municipal discharges or industrial effluents (Purdom and others, 1994)." Of particular concern is the fact that "eleven pesticides that have been identified as potential endocrine disruptors (Keith, 1997) were among the pesticides most frequently detected in NAWQA water samples from agricultural and urban streams (atrazine, metolachlor, alachlor, metribuzin, trifluralin, simazine, 2,4-D, chlorpyrifos, carbaryl, malathion, and dieldrin)."[80]

The findings of the USGS Report highlight the need to recognize endocrine disruption in the registration of pesticides. Numerous other studies over the years have likewise observed the problem first hand. For example, scientists have documented interference with reproduction in red-spotted newts, *Notopthalmus viridescens*, from exposure to endosulfan, a commonly-used

---

[79] USGS 2007 Report

[80] *Id*.

pesticide.[81] The study noted that endosulfan disrupted the development of glands that synthesize a pheromone used in female communication which in turn led to lower mating success. The study revealed an impact at just 5 parts per billion, the lowest concentration used in the study and a concentration which is well within the range of endosulfan contamination regularly encountered in the real world. The study identifies a new mechanism by which low-level contamination can cause adverse effects in wildlife populations. Moreover, another study suggests that an entire class of herbicides can affect nontarget plants and microorganisms at levels so low that they cannot be detected.[82]

Atrazine has been found to disrupt sexual development of frogs at concentrations 30 times lower than levels allowed by EPA.[83] The Hayes study exposed frogs to low levels of atrazine, levels which can often be found in the environment. The results showed that these low levels of atrazine demasculinized male frogs, preventing male characteristics from fully forming – Hayes found hermaphroditism in frogs at exposure levels as low as 0.1 ppb, far below the level established by EPA as safe for aquatic organisms. Hayes noted that amphibians are at great risk because the highest atrazine levels coincide with the breeding season for amphibians. Additionally, the low-dose endocrine-disrupting effects are of great concern because the described effects are all internal and may go unnoticed by researchers. Thus, "exposed populations could decline or go extinct without any recognition of the developmental effects on individuals."[84]

Atrazine is far from alone, however. In a study focusing on the effect of methoxychlor, a substitute for DDT, scientists found that pesticide presence in pregnant mice changed the structure of the male offspring's prostate.[85] This study was done using doses that are encountered in the environment. Another study examined the impacts of pesticides on the expected sex ratio of turtle eggs and found that the sex ratio was altered by each of the pesticides used (a PCB mixture, trans-nonachlor, and chlordane).[86] Specifically, chlordane suppressed

---

[81] Park, D, SC Hempleman, and CR Propper. 2001. Endosulfan exposure disrupts pheremonal systems in the red-spotted newt: A mechanism for subtle effects of environmental chemicals. *Environmental Health Perspectives* 109(7):669-673

[82] Whitcomb, C.E. 1999. An Introduction to ALS-Inhibiting Herbicides. *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 231-239

[83] Hayes, T.B., et al. 2002. Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses. *Proceedings of the National Academy of Sciences*, 99(8):5476-5480; Hayes, Tyrone B., Paola Case, Sarah Chui, Duc Chung, Cathryn Haeffele, Kelly Haston, Melissa Lee, Vien Phoung Mai, Youssra Marjuoa, John Parker, and Mable Tsui. 2006. Pesticide Mixtures, Endocrine Disruption, and Amphibian Declines: Are We Underestimating the Impact? *Environmental Health Perspectives* 114(S-1):40-50

[84] *Id*.

[85] Welshons, W.V., et al. 1999. Low-dose bioactivity of xenoestrogens in animals: fetal exposure to low doses of methoxychlor and other estrogens increases adult prostrate size in mice. *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 12-25

[86] Willingham, E.T., et al. 2000. Embryonic Treatment with Xenobiotics Dsirupts Steroid Hormone Profiles in Hatchling Red-Eared Slider Turtles (*Trachemys scripta elegans*). *Environmental Health Perspectives* 108(4):329-332

testosterone levels in hatchling males and progesterone levels in hatchling females, indicating that chlordane's impact on sex ratio is a result of anti-androgenic activity. Trans-nonachlor worked as an estrogen mimic, while alachlor suppressed testosterone levels but not progesterone levels. The study concluded that the results are important because they illustrate that different hormone disrupting compounds can achieve similar end results via different biochemical mechanisms.

Endocrine disruptors have been linked to asexual development of salmonids as well.[87] Investigating the sex reversal in salmonids, Nagler (2001) postulated that the 84% of phenotypic females which tested positive for the male genetic marker may be attributed to endocrine disrupting compounds. Sex ratio disruption was likewise documented in a study of male water fleas.[88] In the study, dieldrin reduced the number of male Daphnia. The results are of particular concern because insects are at the bottom of the food chain, serving as a food source for many higher life forms including fish. Consequently, this study has implications for wildlife throughout the food web.

Yet another study focused on the reproductive system of frogs (the northern leopard frog, *Rana pipiens*, and green frog, *Rana clamitans*) and tested eight breeding sites, four of which were situated in apple orchards.[89] 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, indicating that mortality in orchard ponds was probably due to stressful environmental conditions. Toxicity tests revealed that the pesticide diazinon (a commonly used pesticide) and the formulations Dithane DG, Gunthion 50WP, and Thiodan 50WP cause mortality, deformities, and/or growth inhibition in embryos and tadpoles. Residues of three of these compounds were detected at the *in-situ* sites.

Gray (1999) found that exposure to pesticides produced diverse reproductive malformations in male rats, including undescended testes, hypospadias, vaginal pouches, and permanent nipples.[90] Also documented in the study were reproductive effects from exposure of low-levels of the fungicide vinclozilin. This study raises concern that some of the antiandrogen effects may have no threshold; that they may be initiated through the slightest increase in antiandrogenic pesticides. Also of particular note is the fact that the interactive effects of multiple contaminants

---

[87] Nagler, J.J., et al. 2001. High Incidence of a Male-Specific Genetic Marker in Phenotypic Female Chinook Salmon from the Columbia River. *Environmental Health Perspectives* 109(1):67-69

[88] Dodson, S.I., et al. 1999. Dieldrin Reduces Male Production and Sex Ratio in Daphnia (*Galeata mendotae*). *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 192-199

[89] Harris, M., et al., Apple Orchard Insecticide and Fungicide Effects on Ranid Populations in Ontario, University of Guelph, Ontario, abstract found at www.pmac.net/ranid.htm

[90] Gray, L.E., et al. 1999. The estrogenic and antiandrogenic pesticide methoxychlor alters the reproductive tract and behavior without affecting pituitary size or LH and prolactin secretion in male rats. *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 37-47

have been found to result in endocrine, immune and behavioral changes, even though no effects were found if rodents were exposed to one chemical alone.[91] The study exposed rodents to concentrations of atrazine, aldicarb and nitrate (all commonly found in the environment) at levels found in the environment.

In sum, pesticides, their degredates, and their potential endocrine-disrupting effects must be analyzed when making effects determinations for listed species. To do otherwise risks ignoring significant pathways for harm, both lethal and sublethal.

### G. Sublethal Effects

While mortality is the ultimate deleterious impact to wildlife, it is not the only significant impact on species. Spalding and Fellers (2009) explain:

> Overt mortality is the most extreme end point of toxicity; however sublethal effects can occur at far lower concentrations than those that result in acute lethality. Other end points include growth, development, time to metamorphosis and, for chlorpyrifos and other organophosphorus pesticides, cholinesterase depression. These factors are important in that they can affect behavior and increase the vulnerability of anuran larvae to predators and to hydrological events.[92]

A 2008 publication addressing pesticide impacts to frogs further demonstrates the importance of assessing sublethal effects.[93] The study notes that "organisms in nature frequently experience multiple applications of pesticides over time rather than a single constant concentration. In addition, organisms are embedded in ecological communities that can propagate indirect effects through a food web." In order to address those issues, the study used low concentrations (10–250 lg/L) of a common insecticide, malathion. The "malathion (which rapidly breaks down) did not directly kill [the] amphibians, but initiated a trophic cascade that indirectly resulted in substantial amphibian mortality." The authors noted that "the trophic cascade is common to a wide range of insecticides (including carbaryl, diazinon, endosulfan, esfenvalerate, and pyridaben), offering the possibility of general predictions for the way in which many insecticides impact aquatic communities and the populations of larval amphibians."

Another study examined the relationship between frog diseases and pesticides and similarly demonstrates how pesticides can harm species indirectly.[94] The researchers showed "that the

---

[91] Porter, W.P., et al. 1999. Endocrine, Immune, and Behavioral Effects of Aldicarb (Carbamate), Atrazine (Triazine) and Nitrate (Fertilizer) Mixtures at Groundwater Concentrations, *Toxicology and Industrial Health: An International Journal*, Vol.15, Nos. 1&2, 133-150

[92] Sparling, Donald W. and Gary M. Fellers. 2009. Toxicity of two insecticides to California anurans and its relevance to declining amphibian populations. *Environmental Toxicology* 28(8):1696-703

[93] Relyea, Rick A. and Nicole Diecks. 2008. An Unforeseen Chain Of Events: Lethal Effects Of Pesticides On Frogs At Sublethal Concentrations. *Ecological Applications* 18(7):1728–1742

[94] Rohr, Jason R., Anna M. Schotthoefer, Thomas R. Raffel, Hunter J. Carrick, Neal Halstead, Jason T. Hoverman, Catherine M. Johnson, Lucinda B. Johnson, Camilla Lieske, Marvin D. Piwoni, Patrick K. Schoff, and Val R.

widely used herbicide, atrazine, was the best predictor (out of more than 240 plausible candidates) of the abundance of larval trematodes (parasitic flatworms) in the declining northern leopard frog *Rana pipiens*. . . . Analysis of field data supported a causal mechanism whereby both agrochemicals increase exposure and susceptibility to larval trematodes by augmenting snail intermediate hosts and suppressing amphibian immunity."

Other sublethal effects include decreased hatchling success and malformations. One study found that malathion decreases hatching success by 6.5% and viability rates by 17%.[95] The primary malformations documented in the two highest pesticide concentrations were ventralization and axial shortening. After seven weeks of development in water with no malathion, tadpoles previously exposed as embryos for only 96 h to 60 and 600 g/L malathion suffered increased parasite encystment rates when compared to controls. Research identifies embryonic development as a sensitive window for establishing latent susceptibility to infection in later developmental stages. Another study found that northern leopard frogs exposed to sublethal levels of DDT and malathion produced dramatically fewer antibodies.[96] The study suggests that frogs exposed to pesticides have immune system changes similar to frogs exposed to immunosuppressants. Another study found that limb deformities in wood frogs due to exposure to trematode infection are more common at sites adjacent to agricultural runoff.[97] The study concludes that stress due to pesticide exposure decreases tadpoles' ability to resist infection.

Metts et al (2005)[98] also highlights the importance of addressing sublethal effects. The Metts study examined the impact of carbaryl, a commonly used insecticide. Carbaryl remains one of the most-utilized insecticides in the United States for home gardens, commercial agriculture, and forestry and rangeland protection.[99] The study looked at two competing species of *Ambystoma* salamanders and the influence of salamander density and carbaryl exposure on salamander populations. Carbaryl has a negative impact on zooplankton, the primary food source of many salamander species in the aquatic life phase. The study found that zooplankton were nearly eliminated by naturally occurring concentrations of carbaryl. A lack of food sources leads to

---

Beasley. 2008. Agrochemicals increase trematode infections in a declining amphibian species. *Nature* 455:1235-1240

[95] Budischak, S. A., L. K. Belden, and W. A. Hopkins. 2008. Effects of malathion on embryonic development and latent susceptibility to trematode parasites in ranid tadpoles. *Environ Toxicol Chem*, 27(12):2496-500

[96] Gilbertson, M., G. D. Haffner, K. G. Drouillard, A. Albert, and B. Dixon. 2003. Immunosuppression in the northern leopard frog (*Rana pipiens*) induced by pesticide exposure. *Environmental Toxicology and Chemistry* 22(1):101-110

[97] Kiesecker, J. M. 2002. Synergism between trematode infection and pesticide exposure: A link to amphibian limb deformities in nature? *Proceedings of the National Academy of Sciences of the United States of America* 99(15):9900-9904

[98] Metts, Brian S., William A Hopkins, and John P. Nestor. 2005. Interaction of an insecticide with larval density in pond-breeding salamanders (Ambystoma). *Freshwater Biology* 50:685–696

[99] Todd, Nancy E. and Maryke Van Leeuwen. 2002. Effects of Sevin (Carbaryl Insecticide) on Early Life Stages of Zebrafish (*Danio rerio*). *Ecotoxicology and Environmental Safety* 53(2):267-272

higher levels of mortality in the salamander larvae. Sharp declines in the number of larvae leads to lower levels of "recruitment," the number of individual larvae that metamorphose into adults. A reduction in recruitment is clearly important because it directly reduces the number of individuals that ultimately become adults and reproduce. Thus, pesticide induced declines in larvae survival and metamorphosis will have significant impacts on salamander populations. Metts et al (2005) noted that "the level of mortality [found in the study] on aquatic life stages would likely have significant effects on terrestrial communities via reductions in salamander recruitment. Indeed, when both species are considered together metamorphosis was 1% and 23% . . . respectively, compared with 86% in controls."

Earlier studies also indicate the significance of sublethal impacts. A series of factsheets documenting the impact of pesticides used for crops and wildlife demonstrate that pesticides may adversely affect wildlife directly, as well as indirectly, by modifying the availability of food or cover. For instance, Palmer et al.[100] found that more than 30% of the quail tested were made sick by one aerial insecticide application. Once sick, wild birds may neglect their young, abandon their nests, and become more susceptible to predators and disease. Other effects to the birds included reduction in food supply (e.g., reduction in insects and plants from insecticides and herbicides) and vegetative cover (which provides brooding cover). Direct and indirect impacts were also found with cotton production.[101] Researches found 60% of tested quail with insecticides in their bodies.

Most recently, sublethal impacts of pesticides to salmon was addressed in the journal Ecological Applications.[102] The article notes that "several current-use pesticides are known to impair the physiology and behavior of salmon. Among the most acutely toxic are the organophosphate (OP) and carbamate (CB) insecticides that target the salmon nervous system." Using "environmentally realistic pesticide exposures", the researchers found that "model outputs showed that a pesticide exposure lasting only a few days can change the freshwater growth trajectory and, by extension, the subsequent survival of subyearling animals." "[A]ll four modeled pesticide exposure scenarios reduced population growth rate and spawner abundance relative to an unexposed Chinook population. These population-scale effects are largely attributable to individual survival rates during the critical first year of the ocean-type life history." Thus, there should be no doubt that pesticides, "via delayed reductions in growth and survival," can have profoundly adverse impacts to wildlife.

---

[100] Palmer, W.E. P.T. Bromely, and J.R. Anderson, Jr., Wildlife and Pesticides—Corn, North Carolina Cooperative Extension Service AG-463-2

[101] Palmer, W.E. P.T. Bromely, and J.R. Anderson, Jr., Wildlife and Pesticides—Cotton, North Carolina Cooperative Extension Service AG-463-4

[102] Baldwin, David H., Julann A. Spromberg, Tracy K. Collier, and Nathaniel L. Scholz. 2009. A fish of many scales: extrapolating sublethal pesticide exposures to the productivity of wild salmon populations. *Ecological Applications* 19(8):2004–2015

As succinctly summarized by Metts et al (2005),[103] sublethal effects can not be ignored if the true impacts of pesticides are to be adequately addressed:

> Although many studies have examined lethal-limits of pesticides on amphibians, environmental concentrations are frequently not high enough to induce direct amphibian mortality. Consequently, assessing the sublethal effects of pesticides may be more relevant.

### H. Multiple Stressors

Because pesticides are not the only threat to amphibian life, their effects can be interrelated with other environmental stressors.

Davidson and Knapp (2007)[104] looked at pesticide impacts on the mountain yellow-legged frog (*Rana muscosa*) and their relationship to other environmental stressors on the species, including non-native predators. The investigators used unusually detailed data sets for a large portion of *R. muscosa's* historic range in California's Sierra Nevada mountains. Habitat characteristics and the presence/absence of *R. muscosa* and fish were quantified at each of 6831 sites during field surveys. Pesticide use upwind of each site was calculated from pesticide application records and predominant wind directions. Using generalized additive models, researchers found the probability of *R. muscosa* presence was significantly reduced by both fish and pesticides, with the landscape-scale effect of pesticides much stronger than that of fish. The degree to which a site was sheltered from the predominant wind (and associated pesticides) was also a significant predictor of *R. muscosa* decline. The study shows that windborne pesticides are contributing to amphibian declines in pristine locations. It is further evidence that multi-factorial causes result in amphibian decline.

Environmental contaminants and disease can likewise synergistically contribute to amphibian population declines. Sub-lethal levels of contaminants suppress amphibian immune defenses and thereby may facilitate disease outbreaks. Davidson et al. (2007)[105] looked at the combined effects of pesticide induced immunosuppression and chytrid fungus on amphibians. This disease is strongly implicated in amphibian declines worldwide, with the discovery of a previously unknown chytrid fungus (*Batra-chochytrium dendrobatidis*) associated with mortality in Australia, North, South, and Central America, and Europe. The Davidson et al.(2007) research was designed to examine the effects of pesticide and chytrid interactions on frogs using laboratory experiments to investigate whether low, sub-lethal doses of carbaryl, a common, current-use pesticide, affected foothill yellow-legged frog (*Rana boylii*) susceptibility to chytrid

---

[103] Metts, Brian S., William A Hopkins, and John P. Nestor. 2005. Interaction of an insecticide with larval density in pond-breeding salamanders (Ambystoma). *Freshwater Biology* 50:685–696

[104] Davidson, Carlos and Roland A. Knapp. 2007. Multiple stressors and amphibian declines: dual impacts of pesticides and fish on yellow legged frogs. *Ecological Applications* 17(2):87–597

[105] Davidson, Carlos, Michael F. Benard, H. Bradley Shaffer, John M. Parker, Chadrick O'Leary, J. Michael Conlon, and Louise A. Rollins-Smith. 2007. Effects of Chytrid and Carbaryl Exposure on Survival, Growth and Skin Peptide Defenses in Foothill Yellow-legged Frogs. *Environ. Sci. Technol.* 41(5):1771-1776

fungus. The foothill yellow legged frog's skin peptides strongly inhibited chytrid growth in vitro, which may explain why chytrid exposure did not result in significant mortality on its own. However, skin peptide defenses were significantly reduced after exposure to carbaryl suggesting that pesticides inhibit the frog's innate immune defense and increase susceptibility to the disease.

Metts et al. (2005)[106] also highlights the importance of addressing the interplay between sublethal effects and environmental stressors:

> Sublethal effects can be exacerbated by environmental factors such as competition and predation (Boone & Semlitsch, 2001; Relyea & Mills, 2001). Understanding interactions between contaminants and environmental factors is ultimately important for drawing realistic conclusions about contaminant effects in complex ecological systems (Hopkins et al., 2002, 2004).

As already explained above, the Metts study examined the impact of carbaryl, a commonly used insecticide. The study found that zooplankton were nearly eliminated by naturally occurring concentrations of carbaryl. A lack of this food source lead to higher levels of mortality in the salamander larvae. Moreover, density of other species competing for food sources also influenced the effect of carbaryl on salamander larvae. The study suggests that the combination of carbaryl exposure and population density of other species can influence the effects that chemical contaminants have on recruitment of adult salamanders. Indeed, another study found carbaryl becomes up to 46 times more lethal when combined with predatory stress.[107]

Similar results have been found with atrazine which was found to decrease embryo survival and increase time to hatching in combination with other stressors.[108] Rohr et al. (2004) suggests that high atrazine levels may lead to increased larval energy expenditures and that resource limitations and drying conditions, coupled with environmentally realistic concentrations of atrazine, can contribute to amphibian declines.

Ultraviolet radiation is another stressor compounded by pesticide exposure.[109] Pesticides, fertilizers, and low pH all interact with UV-B to damage developing amphibians. Another study indicates that UV-B radiation can decrease amphibian hatching success and increase embryonic

---

[106] Metts, Brian S., William A Hopkins, and John P. Nestor. 2005. Interaction of an insecticide with larval density in pond-breeding salamanders (Ambystoma). *Freshwater Biology* 50:685–696

[107] Relyea, R. A. 2003. Predator cues and pesticides: A double dose of danger for amphibians. *Ecological Applications* 13:1515–1521; Relyea, R. A., and M. Mills. 2001. Predator-induced stress makes the pesticide carbaryl more deadly to gray treefrog tadpoles. *Proceedings of the National Academy of Sciences of the United States of America* 98:2491-2496

[108] Rohr, J. R., A. A. Elskus, B. S. Shepherd, P. H. Crowley, T. M. McCarthy, J. H. Niedzwiecki, T. Sager, A. Sih, and B. D. Palmer. 2004. Multiple stressors and salamanders: effects of an herbicide, food limitation, and hydroperiod. *Ecological Applications* 14(4):1028-1040

[109] Blaustein, A. R., J. M. Romansic, J. M. Kiesecker, and A. C. Hatch. 2003. Ultraviolet radiation, toxic chemicals and amphibian population declines. *Diversity & Distributions* 9:123-140

mortality.[110] It also concluded that UV-B can have sublethal effects on amphibians by causing deformities, altering behavior, and slowing growth and development.

In short, the interactive effects of multiple stressors—including multiple contaminants or contaminants in the presence of disease, pathogens, predation, climate change, or altered habitats—are vital to understand the effectrs of pesticides on listed species.

## I. Variability of Pesticide Impacts to Different Species

The impacts of pesticides vary based on the type of pesticide and the species exposed to it. Relyea and Jones[111] examined the toxicity of glyphosate (known as Roundup Original Max®) to thirteen species of amphibian larvae. Glyphosate is the number one herbicide in the world used to promote conifer release in forest management and control agricultural weeds. Its use has surged due to the increased planting of genetically modified crops. In recent years, however, there has been increased attention to the impact of glyphosate formulations containing the popular surfactant polyethoxylated tallowamine (POEA) due to its impacts on amphibians.

Relyea and Jones's study conducted toxicity tests to study the impacts of glyphosate on nine species of larval anurans and four species of larval salamanders from both eastern and western North America. The results of the study provides toxicity estimates across a diverse group of larval amphibians. They found that 96-h exposures under static-renewal conditions resulted in LC50 estimates of 0.8 to 2.0 mg a.e. /L for larval anurans and 2.7 to 3.2 mg a.e. /L for larval salamanders. Many species suffered a substantial increase in mortality with an increase of only 1 mg a.e./L (usually from 1 – 2 mg a.e./L for larval anurans and 2 – 3 mg a.e./L for larval salamanders). Based on these data and toxicity categories defined by FWS and EPA, Roundup Original Max would be classified as moderately toxic ($1 < LC50 < 10$ mg a.e./L) to larval salamanders and moderately toxic to highly toxic ($0.1 < LC50 < 1$ mg a.e./L) to larval anurans, depending upon species.

The Relyea and Jones study not only produced LC50 data on previously examined species, but also included one species of larval anuran from eastern North America (spring peepers) and two species of larval anurans from western North America (Cascades frogs and western toads) that had not been previously tested for glyphosate with a POEA surfactant. The $LC50_{96\text{-h}}$ estimates for these species were very much in line with the other species, suggesting that all nine species of larval anurans (across three families) have very similar sensitivities to glyphosate formulations containing the POEA surfactant. POEA caused mortality to increase from 25 to 98% in gray tree frogs, 2 to 96% in leopard frogs, and 3 to 100% in American toads. In a mesocosm experiment that used one-third as much formulated product (1 mg a.e./L), gray tree frogs experienced no significant mortality, leopard frogs experienced 29% mortality, and American toads experienced

[110] Bridges, C. M., and M. D. Boone. 2003. The interactive effects of UV-B and insecticide exposure on tadpole survival, growth and development. *Biological Conservation* 113:49-54

[111] Relyea, Rick A. and Devin K. Jones. 2009. The Toxicity of Roundup Original Max® to Thirteen Species of Larval Amphibians. *Environmental Toxicology and Chemistry* 28(9):2004–2008

71% mortality. In sum, glyphosate formulations containing the POEA surfactant have the potential to cause substantial amphibian harm at environmentally expected concentrations.

ESA listed amphibian species may be even more susceptible to the adverse effects of pesticide drift than their non-threatened counterparts. Sparling and Fellers (2009)[112] examined the chronic toxicity of two of the most commonly used insecticides in the Central Valley, chlorpyrifos and endosulfan, on larval Pacific treefrogs (*Pseudacris regilla*) and foothills yellow-legged frogs (*Rana boylii*). Sensitivity to exposure to chlorpyrifos and endosulfan varied between the two species of frogs. The estimated median lethal concentration, or LC50, for chlorpyrifos was 365 µg/L in *P. regilla* and 66.5 µg/L for *R. boylii*. Likewise, the time to metamorphosis increased with concentration of chlorpyrifos in both species. Cholinesterase activity, a key step of metamorphosis, declined with exposure concentration (at Gosner stage 42 to 46 metamorphs of both species). Results of the study showed that the effects of these chemicals was more deleterious to *R. boylii* than to P. *regilla.* The authors note the implications of their study on conservation issues:

> Environmentally realistic concentrations of insecticides in the Sierra Nevada Mountains of California may have the ability to inflict serious damage on native amphibians. In comparison to those of several other species, *P. regilla* populations seem to be stable or declining at a slower rate. A possible cause of their relative success is their reduced dependence on standing water. *Pseudacris regilla* adults lay their eggs in water and move to upland habitat shortly afterwards; hatching is rapid compared to some of the other species; and time to metamorphosis is less than that of *R. boylii*. The congeneric *R. muscosa*, which is federally endangered in the southern end of its distribution, can be exposed to water borne contaminants for two to three summers as tadpoles before metamorphosing. Thus, exposure to chlorpyrifos and endosulfan poses serious risk to amphibians in the Sierra Nevada Mountains.

Interestingly, the Metts et al. (2005) study also found that sensitivity to chemical contamination may be highly variable among amphibian species. The responses of the two salamander species to carbaryl varied substantially.[113] In general, *A. opacum* was much more sensitive to carbaryl contamination than *A. maculatum*: "Knowledge of species-specificity in chemical tolerance is critical to identify which species are most susceptible, as well as to help explain why some species or populations suffer declines while others persist."

The above research is also particularly relevant in light of the fact that some pesticide studies in the past have uses *X. laevis* as the target species. "*Xenopus* is like a frog from Mars," says ecologist David Skelly at Yale University. "Using it to evaluate risks to [North American]

---

[112] Sparling, Donald W., and Gary M. Fellers. Toxicity of two insecticides to California anurans and its relevance to declining amphibian populations. *Environmental Toxicology* 28(8):1696-703

[113] Metts, Brian S, William A. Hopkins And John P. Nestor. 2005. Interaction of an insecticide with larval density in pond-breeding salamanders (Ambystoma). *Freshwater Biology* 50:685–696

species doesn't make sense." Therefore, given the variability amongst species, the most sensitive species should be used as the benchmark when making effects determinations.

### J. Mixtures

Combined pesticides can sometimes have greater effects on amphibian survival and growth than individual pesticides.[114] Since mixtures are the norm in the environment, any pesticide impact analysis that fails to address mixtures will fall short of adequately assessing the problem. As discussed in the USGS 2007 Report:

> Samples from streams in areas with substantial agricultural or urban land use *almost always* contained mixtures of multiple pesticides and degradates. More than 90 percent of the time, water from streams with agricultural, urban, or mixed-land-use watersheds had detections of 2 or more pesticides or degradates, and about 20 percent of the time they had detections of 10 or more. In addition, samples of fish tissue and bed sediment from most streams contained mixtures of historically used organochlorine pesticides and their degradates and by-products.
>
> More than 6,000 unique 5-compound mixtures were found at least 2 percent of the time in agricultural streams (only 1 unique 5-compound mixture was found in ground water). Evaluating the potential significance of mixtures can be simplified, however, because many mixtures do not occur very often at high concentrations, and the most frequently occurring mixtures are composed of relatively few pesticides. For example, the number of unique 5-compound mixtures found in agricultural streams is less than 100 when only concentrations greater than 0.1 micrograms per liter (μg/L) are considered. More than 30 percent of all unique mixtures found in streams and ground water in agricultural and urban areas contained the herbicides atrazine (and deethyla-trazine), metolachlor, simazine, and prometon. The insecticides diazinon, chlorpyrifos, carbaryl, and malathion were common in mixtures found in urban streams.

Currently the toxicity of chemical mixtures is not tested as part of the regulatory process. Jones et al. (2009)[115] notes that "the traditional approach has been to assess the direct toxic effects in highly controlled, short-term (i.e., 1- to 4-d) laboratory experiments. Using such experiments, one can estimate the LC50 value of a pesticide (the concentration expected to kill 50% of a population). Unfortunately, amphibians are not tested as part of the registration process for the vast majority of pesticides, so we have few LC50 data for amphibians despite them being a particularly sensitive group." With such pervasive presence of multiple pesticides, any determination of effects performed on a pesticide-by-pesticide basis will clearly fall short of

---

[114] Relyea, R. A. 2004. Growth and survival of five amphibian species exposed to combinations of pesticides. *Environmental Toxicology and Chemistry* 23(7):1737-1742

[115] Jones, Devin K., John I. Hammond, and Rick A. Relyea. 2009. Very Highly Toxic Effects Of Endosulfan Across Nine Species Of Tadpoles: Lag Effects And Family-Level Sensitivity. *Environmental Toxicology and Chemistry* 28(9):1939-1945

truly recognizing the impact the pesticide is or may be having, in combination with other pesticides, on listed species.

Researchers have examined the effects of continuous exposure to environmentally relevant concentrations of two common pesticides, endosulfan and mancozeb, on the growth and survival of leopard frog tadpoles.[116] The concentrations used are comparable to those estimated to be found in water bodies near agricultural fields. Endosulfan is an organochlorine insecticide widely used on food crops. The EPA has estimated the total average annual use of endosulfan in the United States to be 1.38 million pounds of active ingredient. Endosulfan has been known to affect the central nervous system as well as the reproductive system of vertebrates and has been implicated in altered sexual development of males. Mancozeb, another commonly used agrochemical, is a dithiocarbamate fungicide. It is also used extensively in food crops and on turf grass. It was listed among the twenty-five most-used pesticides in the United States in the years 2000 and 2001, with an estimated use of 6 to 8 million pounds of active ingredient. Mancozeb is known to disrupt thyroid functioning and cause physical deformities.

Shenoy et al. (2009) looked at the impacts of endosulfan and mancozeb on tadpoles of the northern leopard frog (*Rana pipiens*), a common North American amphibian species found in a variety of habitats, including agricultural fields and golf courses. Exposure to both mancozeb and endosulfan resulted in significant mortality among the tadpoles. Growth rates were reduced by exposure to mancozeb, though not by exposure to endosulfan. Results demonstrated that even low concentrations, (0.2 μg/L endosulfan and 16 μg/L mancozeb), which may well be expected in water bodies around agricultural fields, can be lethal, or can inhibit growth when sublethal.

Hayes et al. (2006) investigated the "effects of a realistic pesticide mixture composed of chemicals applied to cornfields in York County, Nebraska."[117] They examined the impacts of four herbicides (atrazine, metolachlor, alachlor, and nicosulfuron), three insecticides (cyfluthrin, cyhalothrin, and tebupirimphos), and two fungicides (metalaxyl and propiconizole) alone or in two combinations observed in the wild. The study proposed among other things that the lack of examinations on the effects of low level chemical mixing resulted in underestimates of the impacts of pesticides on wildlife.[118] During the experiments, the study found varying effects on wildlife as a result of mixtures of applied chemicals.

> One of these compounds (propiconizole) retards larval development and delays metamorphosis, and two others (tebupirimphos and cyfluthrin) retard larval growth. In addition to these new data, the present study confirms the retardation of amphibian development (Carr et al. 2003; Rohr and Palmer 2005; Rohr et al.

---

[116] Shenoy, Kausalya, B. Thomas Cunningham,, James W. Renfroe, and Philip H. Crowley. 2009. Growth and Survival of Northern Leopard Frog (*Rana pipiens*) Tadpoles Exposed to Two Common Pesticides. *Environmental Toxicology and Chemistry* 28(7):1469-1474

[117] Hayes, Tyrone B. , Paola Case, Sarah Chui, Duc Chung, Cathryn Haeffele, Kelly Haston, Melissa Lee, Vien Phoung Mai, Youssra Marjuoa, John Parker, and Mable Tsui. 2006. Pesticide Mixtures, Endocrine Disruption, and Amphibian Declines: Are We Underestimating the Impact? *Environmental Health Perspectives* 114(S-1):40-50

[118] *Id*. citing Hayes et al. 2002a, and Burkhart et al. 2003

> 2004) and growth (Boone and James 2003; Britson and Threlkeld 1998; Carr et al. 2003; Diana et al. 2000) already reported for atrazine.

Thus, a mixture of applied chemicals can have cumulative deleterious effects on amphibians that worsen with the addition of more chemical agents into the environment.

Laetz et al. (2009)[119] note that "pesticides almost always occur in mixtures with other pesticides. Analysis of NAWQA monitoring data found that > 90% of water samples from urban, agricultural, and mixed-use streams contained two or more pesticides (Gilliom 2007)." Laetz et al. found that "*in vivo* exposures to binary mixtures of OP and CB pesticides produced additive or synergistic AChE inhibition in the brains of juvenile coho salmon." The researchers pointed out that "[a]t present, diazinon, chlorpyrifos, malathion, carbaryl, and carbofuran are some of the most extensively used insecticides in California and the Pacific Northwest (California Department of Pesticide Regulation 2008)," and the "frequency with which these chemicals are detected in some salmon habitats (Table 1) and their combinatorial toxicity to juvenile salmon when they occur as mixtures suggest they may be limiting the recovery of several threatened and endangered populations . . . . This implies that single-chemical assessments will systematically underestimate actual risks to ESA-listed species in salmon-supporting watersheds where mixtures of OP and CB pesticides occur."

Relyea (2009)[120] researched "how a single application of insecticides (malathion, carbaryl, chlorpyrifos, diazinon, and endosulfan) and herbicides (glyphosate, atrazine, acetochlor, metolachlor, and 2,4-D) at low concentrations (2–16 p.p.b.) affected aquatic communities composed of zooplankton, phytoplankton, periphyton, and larval amphibians (gray tree frogs, *Hyla versicolor,* and leopard frogs, *Rana pipiens*)." The study "examined each pesticide alone, a mix of insecticides, a mix of herbicides, and a mix of all ten pesticides." Instead of testing the infinite pesticide combinations possible, Relyea selected a few broad combinations to determine if any of the concentrations caused deleterious effects unique to chemical mixing. Results of the study show that "a single application of insecticides and herbicides (alone and in combination at low concentrations) can have dramatic effects on several taxonomic groups. For many of the taxa (zooplankton and algae) the effects of the pesticide mixtures were largely predictable from the individual pesticide effects. In contrast, mixtures of globally common pesticides (driven by the mixture of the insecticides) can cause up to 99% mortality in larval amphibians, and this effect was not completely explained by the individual pesticide effects." Relyea concludes:

> Given the constraints of the design when examining ten different pesticides, one cannot determine whether these combined are due to additive or synergistic interactions among the pesticides, but it is clear that the impact can be caused by the five insecticides alone. Thus, future work that examines interactions within this subset of pesticides could determine the underlying mechanisms of leopard frog death. Although the subsequent impact on the terrestrial population of frogs

[119] Laetz,, Cathy A., David H. Baldwin, , Tracy K. Collier, Vincent Hebert, John D. Stark, and Nathaniel L. Scholz. 2009. The Synergistic Toxicity of Pesticide Mixtures: Implications for Risk Assessment and the Conservation of Endangered Pacific Salmon. *Environmental Health Perspectives* 117(3):348–353

[120] Relyea, Rick A. 2009. A cocktail of contaminants: how mixtures of pesticides at low concentrations affect aquatic communities. *Oecologia* 159:363–376

> was not determined (nor estimated via modeling), the sheer magnitude of the larval amphibian mortality would have negative impacts on amphibian populations over time, particularly if these exposures occurred repeatedly. This is a key point in light of amphibian declines occurring throughout the world, including at sites that appear to be relatively pristine but are subjected to atmospheric transport of pesticides at low concentrations from distant areas.

Boone et al. (2003)[121] examined the effects that typical environmental concentrations of an insecticide (carbaryl) and an herbicide (atrazine) have on body mass, development, and survival of frogs (southern leopard frog, *Rana sphenocephala*), toads, (American toad, *Bufo americanus*) and two salamander species that are candidates for listing under the ESA (spotted salamander, *Ambystoma maculatum*; small-mouthed salamander, *A. texanum*). In creating the experiment design, the researchers noted:

> In human-dominated landscapes, [combinations of stressors] can alter species community structure. Because applied research on chemical contaminants has focused on single factors, the effects that multiple anthropogenic stressors have on communities is largely unexamined. If we fail to test multifactor hypotheses, we risk proposing solutions that are too simplistic, thus failing to solve environmental problems (Hilborn and Stearns 1982) at the cost of population and species extinction.

The research yielded varied results based on the types of chemicals tested and species exposed to them. Salamanders were virtually eliminated in carbaryl treatments, indicating that at realistic levels, this insecticide could cause population declines for salamanders in contaminated habitats. Carbaryl also had negative effects on toad survival. Exposure to atrazine had negative effects on body size, development, and time to metamorphosis in frog and toad species, which were associated with reduced chlorophyll levels. Both chemicals interacted significantly with species density or hydroperiod (the time a wetland is inundated with water), indicating that the environmental conditions could influence the impact of a contaminant.

Interactions from mixing were noted as well. A significant atrazine-by-carbaryl interaction resulted in smaller and less developed spotted salamander larvae than in control ponds. Researchers found that carbaryl reduced survival of salamanders, that atrazine had adverse effects on anuran mass and time to metamorphosis, and that both chemicals interacted with other natural factors.

Mixes of different chemicals within one pesticide product can have deleterious impacts as well. Sparling et al. (2006)[122] examined the impacts of glyphosate formulation, Glypro (Dow Agrosciences, Indianapolis, IN, USA), and the surfactant LI700 (Loveland Industries,

---

[121] Boone, Michelle D. and Stacy M. James. 2003. Interactions of an insecticide, herbicide, and natural stressors in amphibian community mesocosms. *Ecological Applications* 13(3):829–841

[122] Sparling, Donald W., Cole Matson, John Bickham, And Paige Doelling-Brown. 2006. Toxicity of Glyphosate as Glypro and LI700 to red-eared slider (*Trachemys scripta elegans*) embryos and early hatchlings. *Environmental Toxicology and Chemistry* 25(10):2768–2774

Cambridge, UK) on red-eared slider (*Trachemys scripta elegans*) embryos. They noted that "approximately 38 to 43 billion kg of glyphosate are applied to more than 8.2 billion ha of cropland, gardens, forests, and wetlands each year." One of the active ingredients in glyphosate, POEA, serves as a surfactant but is actually more toxic than the glyphosate itself. The FWS Pennsylvania Field Office (State College, PA) recognized this risk and tried to develop alternatives to control vegetation in the habitat of the northern bog turtle (*Clemmys muhlenbergii*) which is listed as a federally threatened species. The study showed that glyphosate had several sublethal effects on red-eared slider embryos and hatchlings and that the combination of high concentrations of glyphosate and LI700 can be lethal. It can be inferred that the same sorts of impacts could occur with the northern bog turtle.

These studies demonstrate that chemical mixtures are normal in the environment and must be considered in addressing the effects of pesticides on wildlife. In light of this information, it is EPA's duty to take the lead and begin assessing how mixtures of pesticides are harming threatened and endangered species.

### K. Lag Effects

Often the effects of chemical exposure on amphibians and other wildlife are not immediately apparent. Berrill et al. (1998) reported that the insecticide endosulfan had lag effects in three species of larval anurans (wood frogs, *Rana sylvatica*; American toads, *Bufo americanus*; and green frogs, *Rana clamitans*).[123] This study showed a 4-day lag resulting in mortality after exposure to endosulfan. For American toads, the initial 4-day exposure caused at least 10% mortality in all endosulfan concentrations. After an additional 5 days in clean water, mortality was 60 to 90% in the endosulfan treatments (41, 139, and 252 ppb). For wood frogs, the initial 4-day exposure caused approximately 10% mortality across all endosulfan concentrations. After an additional 7 days in clean water, mortality was approximately 80% in the two lower endosulfan concentrations (68 and 138 ppb) and 100% in the highest endosulfan concentration (364 ppb). For green frogs, the initial 4-day exposure approximately 10% mortality in the endosulfan concentrations (53, 130, and 345 ppb). After an additional 10 days in clean water, mortality was approximately 30% in two endosulfan treatments (53 and 345 ppb) and 80% in the middle concentration (130 ppb).

In a second study examining endosulfan's impact on tadpoles, Relyea added endosulfan at a very low concentration (6 ppb) to mesocosm communities containing tadpoles. The single application of endosulfan killed 84% of leopard frog tadpoles, but this mortality did not appear to occur in the first few days of the experiment.[124] This observation is consistent with Jones et al 2009's discovery of substantial lag effects in leopard frogs, American toads, and spring peepers.

---

[123] Berrill, Michael, Donna Coulson, Lise McGillivray, and Bruce Pauli. 1998. Toxicity of Endosulfan to aquatic stages of anuran amphibians. *Environmental Toxicology and Chemistry* 17(9):1738–1744

[124] R. A. Relyea, personal observation

Jones et al. (2009)[125] point out that "the traditional approach has been to assess the direct toxic effects in highly controlled, short-term (i.e., 1- to 4-d) laboratory experiments. Using such experiments, one can estimate the LC50 value of a pesticide (the concentration expected to kill 50% of a population). Unfortunately, amphibians are not tested as part of the registration process for the vast majority of pesticides, so we have few LC50 data for amphibians despite them being a particularly sensitive group."

As described in Jones et al. (2009), the insecticide endosulfan is a common organochlorine pesticide that has an excitatory effect on the neuromuscular system, can damage gill tissues, and is considered a potential endocrine disruptor. Application rates for endosulfan on crops such as corn, wine grapes, and walnuts average approximately 1.9 kg/ha. Endosulfan can be present at 700 ppb in pond water 10 m away from targeted application sites and 4 ppb in pond water 200 m away from such sites (when sprayed from a nozzle 3 – 4 m above the ground). Endosulfan has also been detected in surveys of amphibians and fish tissues and has been reported to be highly toxic to fish, some amphibians, and crustaceans that inhabit natural ponds and streams.

The results of Jones et al. (2009) show that endosulfan can be very highly toxic to amphibian larvae at low concentrations, that species differ in their sensitivity to endosulfan, and, for several species, the mortality after 4 days of exposure to endosulfan may substantially underestimate the lethality of the pesticide. The researchers note that:

> Using categories defined by the U.S. Environmental Protection Agency (http://www.epa.gov/espp/litstatus/effects/redleg-frog/) and LC504-d estimates from the present study (Table 2), endosulfan would be classified as very highly toxic (i.e., LC50 <100 ppb) to six species (western toads, Pacific tree frogs, gray tree frogs, Cascades frogs, green frogs, and bullfrogs) and highly toxic (i.e., 100 < LC50 < 1000 ppb) to one species (spring peepers). For the remaining two species (American toads and leopard frogs), the LC504-d value could not be estimated because the value is higher than our highest concentration of 60 ppb. However, based on our LC508-d estimates, and assuming that the LC50 for American toads is close to 60 ppb (Fig. 1), endosulfan would be classified as very highly toxic to all nine species (Table 2).
>
> Combining the U.S. EPA chronic estimates with our 8-d lethal concentration values larval populations of leopard frogs, spring peepers, gray tree frogs, Pacific tree frogs, and green frogs could experience an approximate 10% decrease in survival, whereas bullfrog tadpoles could experience an approximate 50% decrease in survival. Combining U.S. EPA acute estimates with 8-d values from the present study, larval populations of western toads could experience an approximate 10% decrease in survival, all of the hylids (spring peepers, gray tree frogs, and Pacific tree frogs) could experience an approximate 50% decrease in survival, and all of the ranids (leopard frogs, green frogs, Cascades frogs, and

[125] Jones, Devin K., John I. Hammond, and Rick A. Relyea. 2009. Very Highly Toxic Effects Of Endosulfan Across Nine Species Of Tadpoles:Lag Effects And Family-Level Sensitivity. *Environmental Toxicology* 28(9):1939–1945

bullfrogs) could experience an approximate 90% decrease in survival. Of course, the true effect of endosulfan exposure on amphibian populations in nature is difficult to estimate due to other potentially additive and synergistic interactions with other pesticides, biotic factors, and abiotic conditions.

Of the nine species tested, two species had significant, small lag effects and another three species (from all three families of anurans) had significant, large lag effects. For example, leopard frogs experienced no significant mortality after the initial 4 d of endosulfan exposure (at 60 ppb) but suffered 97% mortality during the subsequent 4 d while living in clean water. The lag effect is also revealed by changes in the LOEC between days 4 and 8 (Table 2). Collectively, this suggests that the toxicity estimates based on a 4-d exposure to endosulfan could dramatically underestimate the effects of endosulfan on many species of larval amphibians.

Jones et al. (2009) demonstrates that endosulfan can cause high levels of mortality in amphibian larvae at concentrations that are expected and found in nature and that there is a strong lag effect of endosulfan exposure across several species of amphibians. These findings show that predictions based on traditional tests likely dramatically underestimate LC50 values. Consequently, it is extremely important that effects determinations account for lag effects.

## L. Examples of Pesticide Harm

The above studies demonstrate that even when used at or below allowable levels, pesticides can cause serious harm, especially to to endangered and threatened species. Furthermore, the studies demonstrate that previously unconsidered pathways and interactions can heavily influence, and significantly intensify, the adverse effects of pesticides. Until all issues, including mixtures, sub-lethal effects, drift, degradates, lag effects, endocrine disruption, and multiple stressors, are properly analyzed and addressed, threatened and endangered species will not receive the protections required under the ESA.

The following information is provided to further illustrate the wide-ranging reach pesticides pose to ESA listed species and the habitat in which they live, from coast to coast.[126]

### 1. U.S. Watersheds

The USGS has collected data in watersheds throughout the Untied States. That data is presented in Exhibit B, which includes each pesticide detected and the watershed in which it was found. Exhibit B also includes illustrative watershed maps for each pesticide detected by USGS; these maps demonstrate that numerous pesticides are widely present in U.S. watersheds.

[126] These examples are illustrative of the many species/pesticide combinations identified in Exhibit A to this NOI for which EPA is currently in violation of their ESA section 7 obligations.

It is important to note, however, that the the USGS was only searching for particular pesticides as part of this research. In other words, numerous other pesticides are also very likely present in these watersheds but were not detected simply because they were not tested for.

Exhibit B also includes some maps of watersheds polluted with pesticides that overlap critical habiatat of the following species: green sturgeon, West Indian manatee, crocodile, Gulf mollusks, bonytail chub, Gulf sturgeon, Maryland darter, Southwest willow flycatcher, least Bell's verio, California gnatcatcher, southern resident killer whale, bull trout, chum salon, chinook salmon, Rio Grande silvery minnow, slender chub, spotfin chub, Topeka shiner, and bats.

### 2. Amphibians

EPA has already found that the following pesticides are likely to adversely affect the California red-legged frog: 2,4-D, acephate, aldicarb, alachlor, atrazine, azinphos methyl, bensulide, bromacil, carbaryl, captan, chloropicrin, chlorpyrifos, chlorothalonil, DCPA, diazinon, dicofol, diflubenzuron, dimethoate, diuron, disulfoton, endosulfan, EPTC, esfenvalerate, glyphosate, hexazinone, imazapyr, iprodione, linuron, malathion, mancozeb, maneb, metam sodium, methamidiphos, methidathion, metolachlor, methomyl, methoprene, methyl parathion, molinate, myclobutanil, naled, norflurazon, oryzalin, oxamyl, oxydemeton methyl, oxyfluorfen, paraquat, permethrin, pendimethalin, phorate, phosmet, prometryn, propargite, propanil, propyzamide, rotenone, simazine, strychnine, telone, thiobencarb, tribufos, triclopyr, trifluralin, vinclozolin, and ziram. In light of that information, and in light of the fact that amphibians are highly susceptible to pesticides, all listed amphibians are at risk from these pesticides.[127]

### 3. Green Sturgeon

The green sturgeon was listed under the ESA in 2006 and recently received a final rule designating critical habitat. The rule notes that pesticides are likely a very serious threat to the green sturgeon:[128]

> There is evidence that triphenyltin, a common agricultural fungicide, has caused skeletal and/or morphological deformities in Chinese sturgeon (Hu *et al.* 2009). Also, laboratory studies conducted by researchers at UC Davis have shown that certain toxins cause deformities in white sturgeon and green sturgeon (Kruse and Scarnecchia 2002; Feist *et al.* 2005). At this time we do not have information on the effects of the use of agricultural chemicals on green sturgeon in the wild. However, given the similar responses of sturgeon (multiple species) to contaminants as compared to rainbow trout (representing salmonids), the

[127] *See also*, e.g., Whiles, Matt R., John B. Jensen, John G. Palis, and William G. Dyer. 2004. Diets of Larval Flatwoods Salamanders, *Ambystoma cingulatum*, from Florida and South Carolina. *Journal of Herpetology* 38(2):208-214 ("pesticides, alterations of natural hydrologic regimes, or other anthropogenic disturbances that negatively influence aquatic crustacean populations could also impact *A. cingulatum*.")

[128] 74 Fed. Reg. 52300 (October 9, 2009)

application of buffer zones to protect salmonids from the application of pesticides and herbicides would be appropriate.

Suitable water quality would also include water containing acceptably low levels of contaminants (*e.g.,* pesticides, polyaromatic hydrocarbons (PAHs), elevated levels of heavy metals) that may disrupt normal development of embryonic, larval, and juvenile stages of green sturgeon. Water with acceptably low levels of such contaminants would protect green sturgeon from adverse impacts on growth, reproductive development, and reproductive success (*e.g.,* reduced egg size and abnormal gonadal development) likely to result from exposure to contaminants (Fairey *et al.* 1997; Foster *et al.* 2001a; Foster *et al.* 2001b; Kruse and Scarnecchia 2002; Feist *et al.* 2005; Greenfield *et al.* 2005).

The application of pesticides may adversely affect prey resources and water quality within the bays and estuaries. For example, in Willapa Bay and Grays Harbor, the use of carbaryl in association with aquaculture operations reduces the abundance and availability of burrowing ghost shrimp, an important prey species for green sturgeon (Moser and Lindley 2007; Dumbauld *et al.* 2008). In the San Francisco, San Pablo, and Suisun bays, several pesticides have been detected at levels exceeding national benchmarks for the protection of aquatic life (Domagalski *et al.* 2000). These pesticides pose a water quality issue and may affect the abundance and health of prey items as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that may disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments.

Likewise, in the *Proposed Rulemaking to Establish Take Prohibitions for the Threatened Southern Distinct Population Segment of North American Green Sturgeon,*[129] the FWS points out that "the national standards for use of pesticides and toxic substances may not be conservative enough to adequately protect the Southern DPS as was found for listed salmonids in recent draft and final jeopardy biological opinions issued by NMFS to the EPA." This is because the

threatened Southern DPS of North American green sturgeon is at risk of extinction primarily because its populations have been reduced by human 'take,' through activities that include, but are not limited to: . . . (9) application of pesticides adjacent to or within waterways that contain any life stage of Southern DPS fish at levels that adversely affect the biological requirements of the Southern DPS; (10) discharge or dumping of toxic chemicals or other pollutants into waters or areas that contain Southern DPS fish;

The application of pesticides adjacent to or within waterways that contain any life stage of the Southern DPS may adversely affect their growth and reproductive

[129] 74 Fed. Reg. 23821 (May 21, 2009)

success. Several pesticides have been detected in the Sacramento River Basin at levels that are likely to be harmful to aquatic life (Domagalski *et al.*, 2000). The accumulation of industrial chemicals and pesticides such as polychlorinated biphenyls (PCBs), dichloro-diphenyl-trichloroethanes (DDTs), and chlordanes in white sturgeon gonad, liver, and muscle tissues affects growth and reproductive development and results in lower reproductive success (Fairey *et al.*, 1997; Foster *et al.*, 2001a; Foster *et al.*, 2001b; Kruse and Scarnecchia, 2002; Feist *et al.*, 2005; Greenfield *et al.*, 2005). Green sturgeon are believed to experience similar risks from contaminants, although their exposure may be reduced because a greater proportion of their subadult and adult lives are spent in marine waters (70 FR 17386, April 6, 2005). Pesticides may also indirectly affect green sturgeon through effects on their prey species. For example, green sturgeon are believed to enter Willapa Bay to feed on burrowing ghost shrimp (*Neotrypaea californiensis*), which have declined in abundance due to the deliberate application of carbaryl (Moser and Lindley, 2006).

### 4. Indiana Bat

The Missouri Department of Conservation has put out a short document explaining the risks faced by Indiana bats from pesticides: "Indiana bats spend the summer in agricultural areas and are potentially at risk to pesticide contamination. Indiana bats, like many other North American bats, are insectivorous. Contamination of waterways that eliminates aquatic insects may hurt local populations of Indiana bats."[130]

In a 2007 study, Eidels et al. found that three out of nine Indiana bat tissue samples sent through FWS to be tested for toxicants contained chlorpyrifos, methyl parathion and diazinon. Chlorpyrifos was also detected in all six of the dead bats found during the FWS mid-winter surveys in Ray's and Wyandotte Caves.[131]

### 5. Lloyd's Mariposa Cactus and Hinckley's Oak

The Texas Department of Agriculture ("TDA") reports that pesticides may affect Lloyd's mariposa cactus *(Neolloydia mariposensis)* and Hinckley's oak (*Quercus hinckleyi)*, threatened species that occur in Texas. The TDA notes that the following "active ingredients . . . have been identified as being potentially harmful to some plants:"2,4-D, Ammonium sulfamate (discontinued), Bromacil, Clopyralid, Dicamba, Dichlorprop (2,4-DP), Hexazinone, Imazapyr, MCPA (all forms), Metsulfuron methyl, Paraquat, Picloram (all forms), Sulfometuron-methyl, Tebuthiuron, and Triclopy.[132]

---

[130] http://mdc.mo.gov/nathis/endangered/endanger/bat/

[131] Eidels et al. 2007. Insecticide residues in bats and guano from Indiana. *Proceedings of the Indiana Academy of Science* 116(1):50-57

[132] http://www.tda.state.tx.us/agr/program_render/0,1987,1848_5534_5803_0,00.html?channelId=5534

### 6. Illinois Cave Amphipod

The FWS has identified many pesticides that are very likely already harming the Illinois cave amphipod. As discussed in the *Final Rule To List the Illinois Cave Amphipod as Endangered*:[133]

> Water sample analyses from springs, wells, and cave streams in the vicinity of . . . six caves, including one with the species still extant (Fogelpole), have found alachlor and atrazine, the latter at levels approaching those known to cause reproductive impairment in another amphipod species (Panno *et al.* 1996). DDE and dieldrin also were detected in invertebrate samples from Fogelpole Cave.
>
> The agricultural herbicides atrazine and/or alachlor were detected in 83 percent of groundwater samples taken from springs in the study area. The levels of these herbicides in samples often exceeded the U.S. EPA Maximum Contaminant Levels of 2.0 parts per billion (ppb) and 3.0 ppb, respectively, during and following spring rainfalls. They reported maximum atrazine levels in spring samples as high as 98 ppb with the maximum level in Illinois Caverns being 1.38 ppb (Panno *et al.* 1996). Macek *et al.* (1976) observed acute toxicity to the amphipod *Gammarus fasciatus* from a 48-hour exposure to the herbicide atrazine at 2.4 parts per million (ppm). In addition, they reported reproductive effects and impaired survival of offspring from concentrations as low as 0.14 ppm of atrazine during chronic tests lasting 30,119 days (Macek *et al.* 1976).
>
> [A]gricultural chemicals may either be lethal in themselves at certain concentrations, have chronic effects such as inhibiting reproduction, or can leave the amphipod in a weakened condition and less able to cope with short term depressions of dissolved oxygen.
>
> The most commonly used insecticides in the region include carbaryl, carbofuran, chlorpyrifos, malathion, permethrin, methyl parathion, and phosmet. Mayer and Ellersieck (1986) reported that Gammaridae were most sensitive to the five insecticides carbaryl, DDT (dichloro-diphenyl-trichloroethane), endrin, malathion, and methoxychlor and postulated that pesticide pulses characteristic of karst springs could have major impacts on biota such as amphipods. Webb *et al.* (1993) analyzed amphipod and isopod tissue samples from numerous caves, including the three caves known to contain the amphipod, for pesticides and PCB's (polychlorinated biphenyls). DDE (dichlorodiphenyl-dichloroethylene) and DDD (1,1-dichloro,-2,2-bis(p-chloro-phenyl) ethane) (breakdown products of DDT) were detected in isopods from Fogelpole Cave, reflecting the historical use of the insecticide DDT in the drainage basin. In addition, dieldrin, the persistent breakdown product of the insecticide aldrin, was detected in invertebrate samples from Fogelpole Cave. Both DDT and aldrin have been banned from use in the United States since 1973 and 1974, respectively. These data demonstrate some of the long term detrimental effects that agricultural chemicals can have on cave

[133] 63 Fed. Reg. 46900 (September 3, 1998)

> ecosystems. Interestingly, neither DDD, DDE, nor dieldrin were detected in water samples from Fogelpole Cave, supporting the premise that cave invertebrates accumulate and concentrate these toxins even though they do not exist at detectable levels in the cave water: cave invertebrates, therefore, serve as indicators of past and present contamination.

### 7. Cactus Ferruginous Pygmy-Owl

The FWS, in its *Determination of Endangered Status for the Cactus Ferruginous Pygmy-Owl in Arizona,* 62 Fed. Reg. 10730 *(*March 10, 1997) made the following statement regarding pesticide impacts to the owl:

> Pesticides may pose an additional threat to the pygmy-owl where it occurs in floodplain areas that are now largely agricultural. Jahrsdoerfer and Leslie (1988) note that more than 100 pesticides are used on agricultural crops throughout the lower Rio Grande Valley. Pesticide application occurs year-round. Because crops, such as cotton, are grown repeatedly year after year, an accumulation of resistant pesticides may result.
>
> Pesticide contamination is described as "widespread" throughout the inland waters of the lower Rio Grande Valley, and includes concentrations of DDT, dieldrin, endrin, lindane, endosulfan, Guthion, and PCB's which exceeded 1976 EPA criteria for propagation of fish and wildlife. Without appropriate precautions, these agents may potentially affect pygmy-owls through direct toxicity or effects on their food base.

### 8. Aquatic Mussels and Snails of the Mobile River Basin

Listed snails and mussels found in the Mobile River Basin are at significant risk of pesticide harm. A USGS study determined the following:

> Data collection incorporates nine regularly sampled sites, synoptic studies, and coordinated sampling with the ecological and ground-water components of the study. The sites were selected based on environmental setting and areal coverage and were sampled weekly to monthly. The samples were analyzed for nutrients, pesticides, volatile organic compounds (VOCs), major ions, carbon, and sediment.
>
> Results indicate that concentrations of nutrients and pesticides reflect basin land use. Samples from the Tombigbee and Alabama River sites integrate most of the Mobile River drainage basin;
>
> Over 133 samples have been analyzed for pesticides. Low concentrations of pesticides occurred frequently in urban and agricultural basins. The herbicides atrazine and simazine occurred in over 90 percent of the samples. The herbicides metolachlor and tebuthiuron and the insecticide diazinon occurred in over 50 percent of the samples. The herbicides atrazine, simazine, metolachlor, diuron,

> 2,4-D, fluometuron, cyanazine, bentazon, MCPA, and picloram were detected at concentrations greater than 1 microgram per liter (µg/L). The highest atrazine concentration measured among the nine sites was in May 1999 at Bogue Chitto Creek (201 µg/L). Three Mile Creek had the highest median concentration of diazinon, and Cahaba Valley Creek had the highest median concentration of simazine.[134]

Similarly, a FWS report notes that in the Mobile River Basin "mussel populations are exposed to point source pollution and nonpoint source pollution (toxic runoff containing fertilizers, herbicides and pesticides from land use practices)."[135]

### 9. Armored Snail and Slender Campeloma

The FWS has determined that the armored snail and slender campeloma may pose a threat to these two species. The FWS' *Endangered Status for the Armored Snail and Slender Campeloma*,[136] states that "[t]he Round Island, Limestone, and Piney Creek drainages are dominated by agricultural use, primarily cotton (a high pesticide use crop), which makes these creeks susceptible to pesticide contamination. Pesticide containers were found in Limestone and Piney Creeks during site visits in 1997 (J. Allen Ratzlaff, personal observation)." FWS noted that pesticides were found in two of the three drainages during a site visit in 1997.

### 10. Salt Creek Tiger Beetle

The FWS has determined that Salt Creek tiger beetles are likely at great risk of harm due to pesticides. As explained in *Determination of Endangered Status for the Salt Creek Tiger Beetle (Cicindela nevadica lincolniana)*:[137]

> Corn, soybean, and sorghum fields dominate the Little Salt Creek watershed, and are potential sources of pesticide exposure to Salt Creek tiger beetles and their habitat. Insecticides that enter occupied habitats of the Salt Creek tiger beetle through runoff have the potential to directly impact the tiger beetle or indirectly impact through modification of prey availability. There have been no studies to evaluate pesticide exposure and adverse effects to Salt Creek tiger beetles. However, research on ground beetles (*Carabidae*) suggests pesticide exposure may place the Salt Creek tiger beetle at risk as a result of decreased survival and reproduction. This research was discussed in detail in the proposed rule (70 FR 5101; February 1, 2005), and is summarized briefly here. In one study, dietary and topical exposure of ground beetles (*Harpalus pennsylvanicus*) to a carbamate

---

[134] Harned, Douglas A., *The Mobile River Basin Water-Quality Assessment: Results Of Surface-Water Quality Monitoring In Alabama 1999-2000*, U.S. Geological Survey

[135] http://www.fws.gov/Athens/pdf/MobileRiverMussels.pdf; see also http://www.fws.gov/southeast/hotissues/mussels/QandAs.html

[136] 65 Fed. Reg. 10033 (February 25, 2000)

[137] 70 Fed. Reg. 58335 (October 6, 2005)

insecticide (bediocarb) and a chloro-nicotinyl insecticide (imidacloprid) resulted in lethal and sublethal effects (Kunkel *et al.* 2001). Bendiocarb and imidacloprid are used to control insects in corn (Extoxnet 1996). Other carbamate pesticides recommended for use in corn, soybean, and sorghum production in Nebraska include carbofuran, methomyl, thiodicarb, trimethacarb, and carbaryl (Wright *et al.* 1994; Hunt 2003). In a field experiment in England designed to study the effects of pesticides on nontarget invertebrates, researchers found that chlorpyrifos and fonofos (both organophosphate pesticides) affected the activity of ground beetles, and this effect seemed the result of direct toxicity rather than a depleted prey base (Luff *et al.* 1990).

Organophosphate and pyrethroid pesticides are used on corn, soybean, and sorghum crops in Nebraska include chlorpyrifos, malathion, methyl parathion, dimethoate, ethoprop, fonofos, phorate, terbufos, tefluthrin, tralomethrin, permethrin, esfenvalerate, cyfluthrin, zeta-cypermethrin, and lambda-cyhalothrin (Wright *et al.* 1994; Hunt 2003). Salt Creek tiger beetles also may be susceptible and exposed to pesticides applied to control mosquitoes, grasshoppers, and pests in residential yards and gardens. Nagano (1982) reported an entire population of tiger beetles (*Cicindela haemorrhagica* and *C. pusilla*) in Washington State being eradicated by pesticides, while the disappearance of the tiger beetle *C. marginata* in New Hampshire was believed to be the result of insecticide spraying to control salt marsh mosquitoes (Dunn 1978, as cited by Nagano 1982). Insecticides applied to lawns and landscaping in residential and commercial developments near Little Salt Creek have the potential to enter the creek and impact the Salt Creek tiger beetle and its prey base. A local government has proposed for the last 2 years to apply pesticide for the control of mosquitoes along Little Salt Creek where the Little Salt Creek-Roper population exists.

### 11. Roswell Springsnail, Koster's Tryonia, Pecos Assiminea, and Noel's Amphipod

These species are highly susceptible to pesticides. As noted in *Listing Roswell springsnail, Koster's tryonia, Pecos assiminea, and Noel's amphipod as Endangered With Critical Habitat*, 67 Fed. Reg. 6459 (February 12, 2002):

> Reductions in endangered spring snail populations in other parts of the country due to reductions in water quality resulting from contamination by agricultural pesticides and herbicides are well documented (Frest and Johannes 1992, Mladenka 1992). There is evidence that colonies of Utah valvata (Valvata utahensis) and Bliss Rapids snail (Taylorconcha serpenticola) have recently declined or have been eliminated at several sites from changes in water quality due to agricultural and aquaculture wastewater originating outside the area (Frest and Johannes 1992). These two species are similar to the three snail species addressed in this proposal for listing, and as a result the three snail species could also be expected to experience adverse effects in response to environmental contaminants.

### 12. Buena Vista Lake Shrew

The listing designation for the Buena Vista Lake Shrew states that due to the close proximity of shrew habitat to an otherwise agriculturally dominated landscape, the 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."[138] The listing designation also notes that "[r]educed reproduction in Buena Vista Lake Shrews could be directly caused by pesticides through grooming, and secondarily from feeding on contaminated insects."[139] The listing also specifically acknowledges the endocrine-disrupting effects of carbamates and organophosphates, stating that "laboratory experiments have shown that behavioral activities such as rearing, exploring for food, and sniffing can be depressed for up to 6 hours in the common shrew from environmental and dietary exposure to subleathal doses of a widely used insecticide, dimethoate.[140] Such depression in behavioral activities could make the shrews more vulnerable to predation and starvation.[141] Furthermore, shrews may have higher concentrations of pesticides in their system than would normally be available because they may feed heavily on intoxicated arthropods after pesticide applications.[142] Finally, the listing reports that Fresno, Kern, and Tulare counties are the three highest users of pesticides in California.[143]

### 13. Vermillion Darter

FWS has stated that the surviving population of the vermillion darter is currently threatened by pesticides that wash into the streams from runoff.[144] FWS cited to a study (Swann 2000) that attributed a past fish kill to pesticide runoff from urban use. FWS also stated that pesticide registration was one of several federal activities that could impact the darter.[145]

### 14. Carolina Heelsplitter and Appalachian Elktoe

For the Carolina heelsplitter and the Appalachian Elktoe, FWS recognized that pesticides threaten the remaining populations.[146] FWS stated that "pesticide/herbicide applications . . .

---

[138] *Endangered Status for the Buena Vista Lake Shrew*, 67 Fed. Reg. 10101 (March 6, 2002)

[139] *Id*. citing Sheffield and Lochmiller 2001

[140] *Id*. citing Dell'Omo et al. 1999

[141] *Id.*

[142] *Id*. citing Stehn et al. 1976; Schauber et al. 1997; and Sheffield and Lochmiller 2001

[143] *Id*.

[144] *Final Rule to List the Vermillion Darter as Endangered*, 66 Fed. Reg. 59367 (Nov. 28, 2001)

[145] *Id*.

[146] *Proposed Designation of Critical Habitat for the Carolina Heelsplitter*, 66 Fed. Reg. 36229, 36230 (July 11, 2001); *Proposed Designation of Critical Habitat for the Appalachian Elktoe*, 66 Fed. Reg. 9540, 9546 (Feb. 8, 2001)

have the potential to jeopardize the continued existence of the Carolina heelsplitter, and Federal agencies are already required to consult with us on these types of activities, or any other activity, that may affect the species."[147] FWS made the same statement for the Elktoe.[148]

Moreover, according to the FWS, poor water quality and habitat conditions have assisted in the decline of the Appalachian elktoe because freshwater mussels are extremely sensitive to aquatic pollutants, especially during their early development. FWS goes on to state, "Agriculture (both crop and livestock) and forestry operations, roads, residential areas, golf courses, and other land-disturbing activities that do not adequately control soil erosion and storm-water run-off contribute excessive amounts of silt, pesticides, fertilizers, heavy metals, and other pollutants that suffocate and poison freshwater mussels." This species is found only in mountain streams of western North Carolina and eastern Tennessee, and requires clean, well-oxygenated water in order to survive. Because of its limited distribution, populations of this mussel are extremely vulnerable to extinction by a single detrimental event or the cumulative effects of minor activities such as water pollution by pesticides and other toxins.[149]

### 15. California Tiger Salamander

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.[150] 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.[151] Among those chemicals were chlorpyrifos, acephate, fenamiphos, malathion, and endosulfan.[152] However, FWS noted that the identified pesticides provide only a sample of the actual and potential threats. FWS also highlighted certain pesticides such as chlorpyrifos because amphibians, with their permeable skins, readily absorb the chemical, especially when migrating through recently treated fields.[153] 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.[154] Finally, FWS cited to studies by Berril et al. 1998, which reported severe toxicity to amphibians from exposure to endosulfan, including extensive paralysis, delayed metamorphosis and high death rates. FWS stated that "it is apparent that

---

[147] *Id*. at 36236

[148] 66 Fed. Reg. at 9546

[149] http://www.fws.gov/asheville/pdfs/AppalachianElktoe.pdf

[150] *Final Rule to List the Santa Barbara County Distinct Population Segment of the California Tiger Salamander as Endangered*, 65 Fed. Reg. 57242, 57259 (Sept. 21, 2000)

[151] *Id*.

[152] *Id*.

[153] *Id*.

[154] *Id*.

endosulfan is extremely toxic at low concentrations to amphibians."[155] FWS concluded that "[f]ive 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."[156] Additionally, 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."[157]

### 16. Scaleshell Mussel

Surface run-off of pesticides was noted as an "app[arent] . . . contributing factor[] in the degradation of [the Scaleshell mussel's habitat]."[158] FWS went on to state that "[i]n summary, many of the same threats that caused the extirpation of historical populations of scaleshell mussels still exists and continue to threaten extant populations."[159] FWS acknowledges that pesticide registration is a federal activity that could occur and impact the scaleshell mussel.[160]

### 17. Holmgren Milk-Vetch and Shivwits Milk-Vetch

FWS recognized indirect affects of pesticides on Holmgren milk-vetch and Shivwits milk-vetch.[161] Pollination for these species was identified as a long-term concern. FWS acknowledged that increased pesticide use may affect pollinators which in turn would impact both milk-vetch species.[162]

### 18. Spruce-Fir Moss Spider

In designating critical habitat for the Spruce-fir Moss spider, FWS explained that the species was "extremely vulnerable to extirpation from a single event or activity such as . . .

---

[155] *Id*.

[156] *Id*.

[157] *Id*.

[158] *Determination of Endangered Status for the Scaleshell Mussel*, 66 Fed. Reg. 51322, 51334 (October 9, 2001)

[159] *Id*.

[160] *Id*. at 51388

[161] *Determination of Endangered Status for Astragalus holmgreniorum (Holgren milk-vetch) and Astragalus ampullarioides (Shivwits milk-vetch)*, 66 Fed. Reg. 49560, 49564 (September 28, 2001)

[162] *Id*.

pesticide/herbicide application."[163] FWS also identified pesticide applications as an activity which may also jeopardize the continued existence of the species.[164]

### 19. Arroyo Toad

For the Arroyo toad, which is found in agricultural fields, FWS noted that such habitat is probably a sink over the long term due to pesticide applications.[165] FWS went on to state that the use of pesticides and herbicides within or adjacent to Arroyo toad habitat may cause adverse impacts.[166]

### 20. Topeka Shiner

Due to a lack of riparian vegetation buffer strips, FWS stated that pesticide application for agricultural purposes has the potential to impact the Topeka shiner, particularly through runoff following heavy participation events.[167] FWS noted that "there are presently numerous areas along streams without buffers that may impact the species."[168]

### 21. Ventura Marsh Milk-Vetch and the Otay Tarplant

FWS noted that Ventura marsh milk-vetch and the Otay tarplant both have small fragmented ranges, making them especially vulnerable to anthropogenic events such as nearby use of pesticides.[169] For the Ventura marsh milk-vetch, FWS also noted that future suburban and urban uses within proximity of the vetch's preserve can bring expected increases in uses of herbicides and pesticides in proximity of the vetch and that such increases could harm the milk-vetch directly, or alter pollinator or plant associations upon which it depends.[170]

---

[163] *Designation of Critical Habitat for the Spruce-fir Moss Spider*, 66 Fed. Reg. 35547 (July 6, 2001)

[164] *Id*. at 35557

[165] *Designation of Critical Habitat for the Arroyo Toad*, 66 Fed. Reg. 9414, 9415 (Feb. 7, 2001)

[166] *Id*.

[167] *Final Rule to List the Topeka Shiner as Endangered*, 63 Fed. Reg. 69008, 69014 (Dec. 15, 1998)

[168] *Id*.

[169] *Proposed Designation of Critical Habitat for Deinandra conjugens (Otay tarplant)*, 66 Fed. Reg. 32052, 32056 (June 13, 2001); *Final Rule for Endangered Status for Astragalus pycnostachyus var. lanosissimus (Ventura marsh milk-vetch),* 66 Fed. Reg. 27901, 27904 (May 21, 2001)

[170] 66 Fed. Reg. at 27904

### 22. Southwestern Willow Flycatcher

The proximity of the Southwestern Willow Flycatcher to agricultural areas indicates a potential threat from pesticides.[171] FWS noted that pesticides may potentially affect the flycatcher through direct toxicity or effects on their insect food base.[172]

### 23. Callippe Silverspot and Behren's Silverspot Butterflies

The use of insecticides threatens the callippe silverspot and Behren's silverspot butterflys.[173] 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.[174]

### 24. Hine's Emerald Dragonfly

Due to the proximity of Hine's emerald dragonfly habitat to apple and cherry orchards, pesticide drift and runoff was identified as a likely threat.[175]

### 25. Rough Popcornflower

FWS reports that pesticides and herbicides have an indirect effect on Rough Popcornflower because the plant relies on pollinators to reproduce and these insect pollinators are vulnerable to pesticides.[176] FWS also noted 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."[177]

---

[171] *Final Rule Determining Endangered Status for the Southwestern Willow Flycatcher*, 60 Fed. Reg. 10694, 10713 (Feb. 27, 1995)

[172] *Id*.

[173] *Determination of Endangered Status for the Callippe Silverspot Butterfly and the Behren's Silverspot Butterfly and Threatened Status for Alameda Whipsnake*, 62 Fed. Reg. 64306, 64314 (Dec. 5, 1997)

[174] *Id*.

[175] Determination of Endangered Status for the Hine's Emerald Dragonfly (Somatochlora hineana), 60 Fed. Reg. 5267, 5270 (January 26, 1995)

[176] *Endangered Status for the Plant Plagiobothrys hirtus (Rough Popcornflower)*, 65 Fed. Reg. 3866, 3871 (January 25, 2000)

[177] *Id*.

### 26. Howell's Spectacular Thelypody

FWS acknowledges that Howell's spectacular thelypody is "particularly vulnerable to herbicide use" as herbicides may impact pollinator populations.[178]

### 27. Kauai Cave Wolf Spider and the Kauai Cave Amphipod

The use of pesticides for golf courses was identified as a threat to two cave species, the Kauai cave wolf spider and the Kauai cave amphipod.[179] 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.[180] FWS identified that at least 30 different pesticides are used on golf courses in Hawaii.[181] FWS cited to a study by Croft, 1990, that found that predators, such as the Kauai cave wolf spider, are generally more susceptible to insecticides than the target pests.[182] 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, FWS stated that pesticide usage on residential property also poses a "serious threat."[183]

### 28. Ohlone Tiger Beetle

FWS notes that "pesticides could pose a threat to the Ohlone tiger beetle."[184] Specifically, FWS points out that the beetle could be killed from aerial drift or runoff into Ohlone habitat. FWS went on to state 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."[185] FWS concluded that "pesticides … imperil the continued existence of this species."[186]

---

[178] Threatened Status for the Plant Thelypodium howellii ssp. spectabilis (Howell's spectacular thelypody), 64 Fed. Reg. 28393, 28395 (May 26, 1999)

[179] *Final Rule to List Two Cave Animals from Kauai, Hawaii*, 65 Fed. Reg. 2348, 2353 (January 14, 2000)

[180] *Id*.

[181] *Id*.

[182] *Id*.

[183] *Id*.

[184] *Endangered Status for the Ohlone Tiger Beetle*, , 66 Fed. Reg. 50340, 50348 (October 3, 2001)

[185] *Id*.

[186] *Id*.

**29. Mississippi Gopher Frog**

In designating the Mississippi Gopher Frog Distinct Population Segment of the Dusky Gopher Frog as Endangered, the FWS recognized that pesticides may affect the Gopher Frog.[187] FWS cited studies such as Duellman and Trueb 1986, Bishop 1992, Berrill et al. 1997, Bridges 1999, Bridges and Semlitsch 2000 in recognizing the multiple impacts pesticides have on frogs throughout their life cycle.[188]

**30. San Joaquin Kit Fox,[189] Northern Spotted Owl, Mexican Spotted Owl, Fresno Kangaroo Rat, Utah Prairie Dog, Morro Bay Kangaroo Rat, Giant Kangaroo Rat, San Bernardino Kangaroo Rat, Tipton Kangaroo Rat, Stephen's Kangaroo Rat, Amargosa Vole, Black-Footed Ferret, Riparian Woodrat, Pacific Pocket Mouse, Florida Panther, Northern Aplomado Falcon, California Condor, Everglade Snail Kite**

Rodenticides are a serious problem for mammals and birds, particularly birds of prey. Four years ago, the FWS sent a letter to EPA discussing the harm caused by widespread rodenticide use:[190]

> Of the second-generation rodenticides, EPA's analysis finds brodifacoum to have the greatest risk to nontarget organisms, based primarily upon its high secondary toxicity in laboratory studies and protracted retention time in tissue (half-life in liver >200 da s). In addition, it was detected in 240 of the 342 (70%) rodenticide-related mortality incidents in EPA's Ecological Incident Information System (EIIS) at the time of publication of the risk assessment. Secondary exposure to brodifacoum has been implicated in mortality events involving the following: several species of owls, hawks, and vultures; bald and golden eagles; corvids, coyotes, bobcats, and mountain lions; raccoons, the long-tailed weasel, striped skunk, opossum, red and gray foxes; and the Federally endangered San Joaquin kit fox (26 documented kit fox mortalities between 1999 and 2002).
>
> Though restricted to use in or around buildings, this pesticide clearly finds its way into the natural food chain. The probable cause most likely combines the

---

187 *Final Rule to List the Mississippi Gopher Frog Distinct Population Segment of the Dusky Gopher Frog as Endangered*, 66 Fed. Reg. 62993 (December 4, 2001)

188 *Id*.

189 "Twenty-six of the 30 San Joaquin kit foxes from Bakersfield contained at least one anticoagulant, and the most commonly detected anticoagulant was brodifacoum. . . . San Joaquin kit foxes are exposed to anticoagulants in urban environments. Eighty-seven percent of San Joaquin kit foxes in Bakersfield had been exposed to anticoagulant rodenticides, compared to none taken at the control site. . . . Population impacts that jeopardize recovery efforts of San Joaquin kit foxes may occur as a result of widespread anticoagulant exposure." From McMillin, Stella C., Robert C. Hosea, Brian F. Finlayson, Brian L. Cypher, and Abdou Mekebri. 2008. Anticoagulant Rodenticide Exposure in an Urban Population of the San Joaquin Kit Fox. Proc. 23 Vertebr. Pest Conf. (R. M. Tunm and M. B. Madon, Eds.), Published at Univ. of Calit:, Davis. pp. 163-165.

190 USFWS February 2005 letter re Rodenticides

movement of rodents to areas outside buildings between the time of brodifacoum ingestion and death, referential selection of anticoagulant-incapacitated prey by predators, and illegal misuse of the rodenticide. Though the amount of pesticide delivered in an exposed rodent through secondary exposure can vary from a nontoxic to a lethal dose, the physiological persistence of this pesticide allows accumulation from multiple nontoxic doses to reach a lethal dose.

> The second-generation rodenticides bromadiolone and difethialone also pose significant risk to birds and nontarget mammals. Though less acutely toxic than brodifacoum, bromadiolone is believed to persist in tissue for comparable periods and has been detected in 39 mortality incidents involving species similar to those detected with brodifacoum residues.
>
> Widespread nontarget exposure to anticoagulants cannot be disputed. Based on a study of carcasses collected from 1998-2001 in New York State, including samples asymptomatic of anticoagulant exposure submitted for West Nile Virus surveillance, Ward Stone, Wildlife Pathologist for New Yark State Department of Environmental Conservation, concluded that anticoagulants were present in the majority of great homed owls, about half of the red-tailed hawks, and in a substantial fraction of other raptors in New York State (Stone et aI., 2003)1. Detection of more than one rodenticide in a number of these carcasses indicates that a percentage of these birds are acquiring these residues through multiple exposures.

Moreover, EPA itself has acknowledged that extreme harm that can be caused by rodenticides. As stated in EPA's 2008 Risk Assessment for Rodenticides:

> EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Secondary exposure to the second-generation anticoagulants is particularly problematic due to these compounds' high toxicity and long persistence in body tissues (e.g., liver retention half-lives of greater than 300 days). The second generation anticoagulants are designed to be toxic in "a single night's feeding," but since time to death is 5-7 days, the target rodent can feed multiple times before death, leading to a carcass containing residues that may be many times the lethal dose. Additionally, the extended persistence of second-generation anticoagulants in the body of a predator or scavenger can result in adverse effects from additive exposures through multiple feedings that are separated by days or weeks.
>
> EPA's comparative ecological risk assessment evaluated multiple lines of evidence and concluded that the second-generation anticoagulants have greater potential to adversely affect non-target wildlife, especially birds, than the first-

generation anticoagulants. These lines of evidence include acute toxicity, persistence of compounds in body tissues of primary consumers (i.e., bait eaters), information from laboratory and pen studies in which poisoned prey are fed to predators or scavengers in various amounts for one or more days, data from field trials and operational control programs, and wildlife mortality incidents. In some wildlife mortality incident reports, the relationship between rodenticide exposure and incident outcome is not established, although in many of the cases the examining toxicologist or pathologist concluded that a rodenticide likely caused or contributed to the mortality. Anticoagulants typically do not cause death until 5-7 days or more after a lethal dose is ingested, and exposed individuals become progressively weaker and lethargic due to blood loss. Thus even in incident cases where rodenticide exposure was established but the proximate cause of death may be identified as predation, disease, or automobile collision, a toxicologist or pathologist may be able to conclude that rodenticide-induced blood loss increased the vulnerability of the animals. Even if a cause-effect relationship with rodenticides has not been determined for some of the wildlife mortality incidents reported to the Agency, the routine detection of rodenticides in a wide variety of non-target wildlife, both birds and mammals, confirms that rodenticide exposure routinely occurs.

As discussed in EPA's updated ecological incident report, several monitoring programs have found that major portions of some non-target animal populations are being exposed to second-generation anticoagulant rodenticides. Incident reports have identified many taxa of non-target animals exposed to rodenticides, including strict carnivores such as mountain lions, bobcats, hawks and owls; omnivores such as coyotes, foxes, skunks and raccoons; and granivores and herbivores such as squirrels and deer. EPA's updated rodenticide ecological incident report documents anticoagulant residues in 27 avian species and 17 mammalian species. For some species (e.g. bobcats, foxes, great horned owls), carcasses frequently contain residue of two or more anticoagulants, usually second generation compounds. In approximately 50% of those incidents, necropsy results indicate that it is highly probable that a second-generation anticoagulant was the cause of the death. The frequency with which second-generation anticoagulants are found is highly significant. EPA believes that widespread exposures to second-generation anticoagulants are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide. Additionally, second-generation anticoagulants have been identified as an environmental issue in many countries, including Canada, the United Kingdom, France, and New Zealand, through incident monitoring and research.

Despite this knowledge, and despite efforts from the FWS requesting consultations regarding rodenticides,[191] the EPA has not initiated, or reinitiated, consultation regarding the effects of rodenticides on these species.

**31. San Marcos Salamander, Fountain Darter, and San Marcos Gambusia**

The Conservation Management Institute of Virginia Tech notes that a major cause for the current endangered state of the San Marcos Salamander is the increasing amount of pesticides and herbicides which runoff into the San Marcos River.[192] These toxins may threaten additional endangered species found in the river, including the Fountain Darter (*Etheostoma fonticola*) and the San Marcos gambusia (*Gambusia georgei)*.

**32. Santa Cruz Long-Toed Salamander**

The Conservation Management Institute of Virginia Tech lists "the controlled use of pesticides" as one of the activities necessary to restore this species to non-endangered status.[193]

**33. Etowah Darter**

The Georgia Department of Natural Resources (GDNR) published a document on protected animals in Georgia, which states that the Etowah Darter is threatened by the runoff of contaminants. The GDNR recommends that runoff of contaminants such as fertilizers, pesticides, heavy metals, and surfactants be eliminated in order to protect the aquatic habitat of this species. This applies to the Etowah River system to which the Etowah Darter is endemic.[194]

---

[191] The FWS recently submitted letters to EPA in September and November of 2009 requesting consultation regarding diphacinone and chlorophachinone. The Letters noted that:

> The list of species potentially affected by anticoagulants is larger now than at the time of the 1993 Biological Opinion. There are more than twice as many species now listed under ESA thereby increasing the chances of listed species potentially be adversely affected. Additionally, the new label expands usage of …diphacinone to control prairie dogs, which is a new use and one that greatly expands the potential for secondary poisoning of listed species and migratory birds. We consider the use of diphacinone to control prairie dogs to be a new use. Accordingly, we requested EPA to consider reinitiating section 7 consultation regarding the use of anticoagulants to control prairie dogs in letters to EPA dated May 5, 2006 and September 8, 2009, and in a conference call with EPA on May 19, 2006. However, this consultation has not been reinitiated.
>
> The use of these products reflects a lack of consideration for the environmental ramifications of indiscriminant toxicant use to control wildlife species ….

[192] http://fwie.fw.vt.edu/WWW/esis/lists/e202003.htm

[193] http://fwie.fw.vt.edu/WWW/esis/lists/e201001.htm

[194] http://georgiawildlife.dnr.state.ga.us/assets/documents/gnhp/etheostoma_etowahae.pdf

### 34. Ozark Cavefish

The Ozark Cavefish's habitat consists of cave springs in the Spingfield Plateau of the Ozark Highlands in southwest Missouri. According to the Missouri Department of Conservation Endangered Species Guidesheet, the Ozark cavefish is in jeopardy due to water pollution, habitat destruction, and human disturbance. "Urban and agricultural pesticides that enter streams and sinkholes may travel miles underground and pollute cavefish habitat," as revealed by the guidesheet.[195]

### 35. Alabama Cave Shrimp

This species has only been found in the Shelta and Bobcat Caves and the Hering, Glover, and Brazelton Cave complex located in Madison County, Alabama. In a five-year review conducted by the FWS, it was stated that urbanization of areas surrounding Shelta and Bobcat Caves, as well as development in the recharge area of the HGB cave system may have caused contamination of the aquifers containing this species. Surface pollutants can quickly and easily enter the aquifer, especially during storms. FWS states that groundwater contamination may result from "sewage leakage, industrial contaminants, road and highway runoff, toxic spills, pesticides, and siltation" and that groundwater contamination is likely the greatest threat to populations of this shrimp.[196]

In 1990 the FWS collected water and sediment samples in order to determine whether contaminants were present and contributing to the decline of aquatic life in Shelta Cave. They found detectable traces of several potentially harmful contaminants, and concentrations of heptachlor epoxide at levels capable of harming aquatic cave species: "Chlordane, dieldrin, and heptachlor epoxide concentrations detected in Shelta Cave sediments were believed capable of biologicallly impairing Shelta Cave's aquatic ecosystem. DDT, DDD, and DDE also appeared in the sediment samples, but at concentrations too low to clearly predict adverse biological effects."[197]

In addition, the Redstone Environmental Office has detected TCE (trichloroethylene) in several of the groundwater monitoring wells northeast of Bobcat Cave. The FWS also states in their five-year report that the Alabama Cave Shrimp found in the HGB caves will be in danger of surface water and groundwater contamination from "sewage leakage, lawn fertilizers, pesticides, and increased surface runoff from residential development in the near future." The FWS recommends, as part of its recommendations for future actions in order to protect the Cave Shrimp, that "special attention be placed on the levels and trends of persistent current-generation pesticides, and other parameters associated with urban runoff."[198]

---

[195] http://mdc.mo.gov/nathis/endangered/endanger/cavefish/

[196] http://www.fws.gov/southeast/5yearReviews/5yearreviews/05-ALS-cave-shrimp-final-5yr.pdf

[197] http://www.fws.gov/cookeville/pdfs/CO-90-4057.pdf

[198] http://www.fws.gov/southeast/5yearReviews/5yearreviews/05-ALS-cave-shrimp-final-5yr.pdf

### 36. Chipola Slabshell

The Florida Fish and Wildlife Conservation Commission recommends banning the use of agricultural pesticides on porous soils near streams, in order to protect and manage the Chipola Slabshell which is found only in the Chipola River system.[199] In a 2007 annual report by the Florida Pesticide Review Council, it was stated that the Chipola River basin includes "predominantly agricultural lands that can impact groundwater quality and numerous private wells."[200]

### 37. Clubshell

According to the Michigan Natural Features Inventory, the decline of this species "has been mainly attributed to pollution from agricultural runoff and alteration of waterways . . . ." where the Clubshell occurs.[201] In a 1994 Recovery Plan report submitted by FWS, it was reported that much of the remaining range for this mussel occurs in agricultural land subjected to pesticide and fertilizer runoff: "Although effects of pesticides are species-specific, in general sub-lethal levels of PCBs, DDT, Malathion, Rotenone, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Mussels were more sensitive to pesticides than many other animals tested. It is not known to what extent the clubshell and riffleshell are affected by pesticides, but these mussels undoubtedly are adversely affected to some degree by these pollutants."[202]

### 38. Purple Bean

The collapse of the Purple Bean and four other mussel species is described in the 2004 Recovery Plan: "The species and their habitats are currently being impacted by excessive sediment bed loads of smaller sediment particles, changes in turbidity, increased suspended solids (primarily resulting from nonpoint-source loading from poor land-use practices and lack of, or maintenance of, best management practices), and pesticides."[203]

### 39. Rough Pigtoe

The survival and reproduction of this species relies on an undisturbed habitat and an adequate population of fish in order for larvae to complete development. FWS states that the habitat of this mussel has been severely damaged or altered by dam construction, agricultural runoff, chemical pollution from agricultural pesticides and industrial wastes, and pollutants from mining operations.[204]

---

[199] http://myfwc.com/docs/FWCG/chipola_slabshell.pdf

[200] http://www.flaes.org/pdf/PRC%20annual%20rep%2006-07.pdf

[201] http://web4.msue.msu.edu/mnfi/abstracts/zoology/Pleurobema_clava.pdf

[202] http://www.fws.gov/northeast/nyfo/es/clubshell.pdf

[203] http://www.cumberlandhcp.org/files/purple_bean_species_acct.pdf

[204] http://www.fws.gov/midwest/endangered/clams/rough_fc.html

#### 40. Bliss Rapids Snail and Snake River Physa

According to Idaho Fish & Game, eutrophication of the middle Snake River has resulted due to agricultural pollution, freshwater aquacultures, human settlement, and industrial development.[205] In addition, the Idaho Bureau of Land Management's (IBLM) 1996 document entitled *Sensitive Animals of the Jarbidge Resource Area, Idaho* identifies "degraded water quality from irrigated agriculture (waste water containing fertilizers, herbicides and/or pesticides) . . . ." as being threatening to the species.[206]

#### 41. White Wartyback

FWS cites reasons for the endangered status of this mussel as being due in part to pollution from agricultural and industrial runoff. "These chemicals and toxic metals become concentrated in the body tissues of filter-feeding mussels such as the white wartyback, eventually poisoning it to death."[207]

#### 42. Cape Fear Shiner

Endemic to the upper Cape Fear River basin in North Carolina, the Cape Fear shiner is threatened by habitat degradation due in part to water pollutants including pesticides. FWS states, "The Cape Fear shiner is sensitive to chemicals found in fertilizers, pesticides, and other sources that pollute water. These and other pollutants include water runoff from farms, municipalities and businesses and their associated infrastructure."[208]

#### 43. Slender Chub

The Slender chub inhabits the Upper Tennessee River Basin of Tennessee and Virginia. According to USGS, pesticides are widely used in the Upper Tennessee River Basin for the limitation of insects, fungi, weeds, and other unwanted organisms:

> Although pesticides usually are applied to specific areas and directed at specific organisms, these compounds often become widely distributed and pose hazards to nontarget organisms. Of 18 sites sampled for organochlorine residues in bottom material and biota in the Upper Tennessee River Basin, chlordane was detected at three sites and dieldrin and DDT-related residues at two sites.

---

[205] http://fishandgame.idaho.gov/cms/tech/CDC/cwcs_appf//Snake%20River%20Physa.pdf

[206] http://www.blm.gov/pgdata/etc/medialib/blm/id/publications/technical_bulletins/tb_96-10.Par.74878.File.dat/part1.pdf

[207] http://www.fws.gov/Midwest/endangered/clams/warty_fc.html

[208] http://www.fws.gov/nc-es/es/CFS_Fact_Sheet2.pdf

> Pesticide use in the Upper Tennessee River Basin is primarily for agricultural purposes. Herbicides, including atrazine and its degradation product, deethylatrazine, had some of the highest application rates and were also among the most frequently detected pesticides in the basin. Herbicides were detected in 98 percent of the 428 surface-water samples collected; atrazine was found in 91 percent and deethyl-atrazine in 86 percent. Metolachlor and simazine were detected in 62 and 40 percent, respectively. Tebuthiuron and prometon, which are used most commonly in noncrop areas, were also among the most frequently detected herbicides (in 58 and 31 percent of the samples collected, respectively). The most frequently detected insecticides were diazinon (12 percent), carbaryl (10 percent), and chlorpyrifos (10 percent), all of which are used on a variety of crops to control pests.[209]

### 44. Spotfin Chub

Populations of the Spotfin chub could be easily wiped out due to pollutants because this species only exists in short reaches of river. FWS advises caution with the use and disposal of pesticides and fertilizers near creeks in order to protect remaining populations.[210]

### 45. Pygmy Madtom

The Pygmy Madtom is found only in the Clinch and Duck River in Tennessee. In the main stem of the Clinch River, land use is predominantly agricultural. The Duck River passes through agricultural land as well, and already at least 35 species of mussels have been lost due to development and agriculture, chemical pollutants and effluents in this river. According to FWS, the madtom was listed due in part to threats of water quality degradation and pollution.[211]

### 46. Cahaba Shiner

The remaining population of Cahaba shiners is restricted to a 15-mile stretch of the main stem of the Cahaba River, as well as in the Locust Fork River in the Black Warrior Basin. According to "*The State of Alabama's Rivers,*" the pesticides atrazine, alaclore, pentachlorophenol, and 2,4-D were all detected in the main stem of the Lower Cahaba River, and were among the highest levels detected in the system.[212]

---

[209] http://pubs.usgs.gov/circ/circ1205/major_findings2.htm; http://www.fws.gov/northeast/virginiafield/pdf/endspecies/fact_sheets/slender%20chub.pdf

[210] http://www.fws.gov/nc-es/fish/spotfinch.html

[211] http://www.fws.gov/cookeville/docs/pygmy_madtom.html; http://www.state.tn.us/environment/na/scenicrivers/duck.shtml

[212] http://www.riversofalabama.org/Cahaba/Species%20Diversity.htm; http://www.ag.auburn.edu/auxiliary/BC/PAGESL1/EnvFacts/EnvFactPagesL2/EnvFactsWATER/EnvFacts Water_Texts/stofALRvrs4.doc

### 47. Mississippi Gopher Frog

"Some chemicals used as herbicides and pesticides are known to be toxic to aquatic amphibians. Since there is only one remaining pond for the Mississippi gopher frog population, any sedimentation or toxic run-off that reaches the pond could destroy the pond and injure or kill tadpoles and adult frogs."[213]

### 48. Frosted Flatwoods Salamander

FWS notes,

> Pesticides (including herbicides) may pose a threat to amphibians, such as the frosted flatwoods salamander, whose permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb 1986, pp. 199200). Negative effects that commonly used pesticides and herbicides may have on amphibians include delayed metamorphosis, paralysis, reduced growth rate, and mortality (Bishop 1992, pp. 6769). Herbicides used near frosted flatwoods salamander breeding ponds may alter the density and species composition of vegetation surrounding a breeding site and reduce the number of potential sites for egg deposition, larval development, or shelter for migrating salamanders. Aerial spraying of herbicides over outdoor pond mesocosms (semifield approximations of ponds) has been shown to reduce zooplankton diversity, a food source for larval frosted flatwoods salamanders, and cause very high (68 to 100 percent) mortality in tadpoles and juvenile frogs (Relyea 2005, pp. 618-626). The potential for negative effects from pesticide and herbicide use in areas adjacent to breeding ponds would be reduced by avoiding aerial spraying (Tatum 2004, p. 1047).[214]

### 49. Houston Toad

University of Michigan's Museum of Zoology Animal Diversity Web states that pesticide run-off has helped limit the number of suitable breeding ponds for remaining populations of this toad.[215]

### 50. Columbia White-tailed Deer

In the article *Genital abnormalities in white-tailed deer (Odocoileus virginianus) in west-central Montana: pesticide exposure as a possible cause*, from the Journal of Environmental Biology,

---

[213] http://www.fws.gov/southeast/publications/gopher.pdf

[214] *Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for Reticulated Flatwoods Salamander; Proposed Designation of Critical Habitat for Frosted Flatwoods Salamander and Reticulated Flatwoods Salamander*, 73 Fed. Reg. 54125, 54131 (September 18, 2008)

[215] http://animaldiversity.ummz.umich.edu/site/accounts/information/Bufo_houstonensis.html

endocrine disrupting pesticides are discussed as possible causes of genital abnormalities in populations of male Columbian white-tailed deer.[216]

## M. Pesticide Descriptions[217]

### 1. Pesticide Classes

#### a. Insecticides

Insecticides are used in agricultural, commercial, and residential settings to control arthropod and arachnid insect pests. Aquatic arthropods such as crustaceans and aquatic insects are also sensitive to insecticides. Because many insecticides work by mechanisms of action that also apply in mammalian, avian, fish, amphibian and reptile species, they can be broadly toxic to many animal taxa groups. Insecticides can also have indirect effects on endangered species by virtue of their toxicity to the food sources; for example, some fish species are not particularly sensitive to some types of insecticides, yet the aquatic insects that they rely on for a food supply can be eliminated by a toxic pulse of pesticide from field runoff. Plants may also suffer from loss of pollinators killed by insecticides.

The different classes of insecticides may have differing relative toxicity to different taxa groups. The neurotoxic organochlorine, organophosphorus and carbamate insecticides are typically quite acutely toxic to birds, mammals and fish. The pyrethroid insecticides are generally less acutely toxic to mammals and birds, but remain highly acutely toxic to aquatic organisms. Pyrethroid insecticides may also cause chronic effects on reproduction, through disruption of the endocrine system. Recently, concerns have been raised about the potential for population-level effects of the neonicotinoid insecticides on honeybees and other pollinators. Persistent insecticides such as some of the pyrethroids have been shown to affect benthic species in creeks receiving runoff from agricultural and residential areas where the pesticides are used.

#### b. Herbicides

Herbicides are used in agricultural, commercial, and residential settings to control terrestrial and aquatic weeds. Many herbicides are quite water soluble with low affinity for soils and thus have potential to run off into aquatic ecosystems where they may pose a risk to aquatic species. Both runoff and spray drift of herbicides into aquatic and terrestrial habitats can destroy plant cover used for habitat and food for endangered animals, leading to indirect effects on endangered species. Although generally less acutely toxic than insecticides, many herbicides may cause chronic effects on reproduction, through disruption of the endocrine system or by other mechanisms.

Several classes of herbicides stand out as potentially problematic for endangered species. Some of the chloroacetanilide herbicides are toxic to certain species of mammals, birds, crustaceans and fish, as well as non-target plants. Triazine herbicides have been associated with endocrine

---

[216] Hoy JA, Hoy R, Seba D, Kerstetter TH. 2002. Genital abnormalities in white-tailed deer (*Odocoileus virginianus*) in west-central Montana: pesticide exposure as a possible cause. *J Environ Biol.* 23:189–197

[217] Much of the scientific work performed for this NOI was conducted by the Pesticide Research Institute.

disruption, with effects on the reproductive and immune systems capable of compromising populations of endangered species. Sulfonylurea and pyridinecarboxylic acid herbicides are exceptionally long-lived and can have long-lasting impacts on endangered plants and species that depend upon them for survival.

### c. Rodenticides

Rodenticides are used to control mice, rats, gophers, rabbits and other rodents in agricultural, residential, and commercial settings. There is potential for risk not only to endangered rodents, but also to the many predator species that depend on rodents as food. Raptors, scavengers such as the California condor, snakes, mammalian predators such as mountain lions and foxes, and even some frog species are all vulnerable from ingesting poisoned rodents. Species that utilize rodent burrows as shelter may be affected through use of burrow fumigants such as sodium and potassium nitrate or aluminum or magnesium phosphide. EPA's 2008 rodenticide cluster assessment led to some improvements in managing rodenticides in an attempt to prevent effects on non-target species, but no formal consultation with the FWS was initiated during this process.

Rodenticides fall into several categories, such as first-generation anticoagulants (warfarin, chlorophacinone, and diphacinone) and second-generation anticoagulants (brodifacoum, difethialone, bromadiolone and difenacoum). Second-generation anticoagulants are especially problematic because the time between ingestion and death can be as long as five days. Additionally, second-generation anticoagulants can persist in body tissues for nearly one year and can cause secondary poisoning to predators over extended periods of time.

### d. Fumigants

Fumigant pesticides (methyl bromide, methyl iodide, metam and dazomet salts, chloropicrin and 1,3-dichloropropene) are used in pre-plant soil treatments to kill nematodes, fungal pathogens and weed seeds. They are used at application rates between 50 and 400 pounds per acre and are all highly volatile, vaporizing to form gases that drift away from the application site and into neighboring areas. EPA has not required sufficient data for a comprehensive ecological analysis, and the Agency has not prioritized these chemicals for ecological risk assessment, assuming that effects are minimal with little data to support that conclusion. In fact, many of these chemicals are neurotoxic and/or highly irritating and used at such high application rates that animals adjacent to fumigation sites will find it impossible to avoid inhalation exposure at levels that could be fatal or severely damaging to the individual. Spills of liquid fumigants into waterways can be similarly devastating to aquatic life.

### e. Fungicides

Fungicides are used against molds, mildews, soil pathogens, and in wood preservation. As a group, fungicides are heterogeneous and diverse and may affect a wide variety of endangered species through various mechanisms. Acute effects to aquatic species are particularly notable for fungicides. Endocrine disruption is also a potential effect of exposure to many fungicides, with effects on reproduction and the immune system.

2. **Pesticide Toxicity**

Exhibit C to this NOI illustesr how toxicity was determined, in part, for each of the pesticides included in this NOI .

3. **Pesticide Categories**

The pesticides included in this NOI fall into three categories (see Exhibit D to this NOI which shows the categories that each pesticide falls into)

Category 1 pesticides are those for which the EPA has indicated that estimated environmental concentrations (EECs) are likely to exceed LOCs for endangered species, and/or may cause indirect effects on endangered species by altering habitat or food sources. Category 1 contains 250 chemicals.

Category 2 pesticides are included based on the following criteria:

1) The chemical is "highly acutely toxic" or "very highly acutely toxic" to one or more taxa groups. These toxicity rankings are based on LD50 or LC50 (lethal dose to 50% of the test organisms or lethal concentration for 50% of the test organisms) data in one or more of three databases that the EPA maintains: AQUIRE, Terretox, and the EPA database of ecotoxicity studies used in registration decisions or,

2) The chemical is a suspected endocrine disruptor, based on inclusion in one of several publications:

   a. Report on Endocrine Disrupting Chemicals, Illinois EPA (February, 1997).
   b. Auxiliary Matters with Estrogenic Effects, Danish EPA, April, 2000.
   c. Towards the Establishment of a Priority List of Substances for Further Evaluation of Their Role in Endocrine Disruption, Appendix 1. BKH Consulting Engineers and TNO Nutrition and Food Research (June 21, 2000). http://ec.europa.eu/environment/endocrine/strategy/substances_en.htm.
   d. Colborn T. Widespread pollutants with reproductive and endocrine-disrupting effects. Our Stolen Future web site, http://www.ourstolenfuture.org/Basics/chemlist.htm.
   e. Keith L. Environmental Endocrine Disruptors: A Handbook of Property Data, Wiley Interscience (New York, 1997).
   f. Benbrook C. Growing Doubt: A Primer on Pesticides Identified as Endocrine Disruptors and/or Reproductive Toxicants, National Campaign for Pesticide Policy Reform (Washington, DC, September 1996).

Category 2 contains 306 chemicals, 173 of which are also in Category 1.

Category 3 pesticides are those chemicals which do not fall into Category 1 or 2 but nonetheless, data exist in regulatory reports from other agencies, the peer-reviewed literature, or in Materials

Safety Data Sheets indicating high toxicity to some taxa groups.  Category 3 contains 12 chemicals.

### 4. EPA Pesticide Statements

For numerous pesticices, EPA has indicated that EECs are likely to exceed LOCs for endangered species, and/or may cause indirect effects on endangered species by altering habitat or food sources.  The following table presents excerpts from EPA documents that highlight these concerns. Common abbreviations used include:

| | |
|---|---|
| EEC | Expected environmental concentration |
| EFED | U.S. EPA's Environmental Fate and Effects Division |
| ESU | Evolutionarily significant unit |
| GENEEC | GEEneric Expected Environmental Concentration program, EPA's Tier 1 screening level assessment tool used to model water contamination |
| LC50 | Concentration that is lethal to 50% of a species population, determined by laboratory tests. |
| LOC | Level of concern |
| PRZM/EXAMS | U.S. EPA's Tier II model used to estimate potential water contamination from pesticide use scenarios. |
| RED | Reregistration Eligibility Decision document |
| RQ | Risk quotient, the ratio of the EEC to the concentration of concern for a particular taxa group. |
| USFWS | U.S. Fish and Wildlife Service, also abbreviated FWS |

| **Pesticide** | **U.S. EPA Statements Indicating Concerns for Endangered Species** |
|---|---|
| 1,3-Dichloropro-pene | From 1998 RED for 1,3-Dichloropropene http://www.epa.gov/pesticides/reregistration/REDs/0328red.pdf:<br><br>The results of the GENEEC model indicate that aquatic acute high risk, restricted use, and endangered species levels of concern are exceeded for freshwater fish at application rates equal to or above 177 lbs a.i./acre. Aquatic acute high risk, restricted use, and endangered species levels of concern are exceeded for freshwater invertebrates at application rates equal to or above 177 lbs a.i./acre from the GENEEC model. |
| 1080 | From 1998 RED (EPA-HQ-OPP-2007-0944-0004) for 1080 http://www.regulations.gov/search/Regs/home.html#documentDetail?D=EPA-HQ-OPP-2007-0944-0004:<br><br>Based on a variety of studies that have been reviewed by the Agency, the principal source of risk is exposure of scavengers feeding on the head and neck area of dead livestock bearing the sodium fluoroacetate livestock protection collars. |

| | |
|---|---|
| | (a) Birds<br>The chemical is very highly toxic to birds on an acute oral basis. Certain bird species may be exposed, primarily as a result of scavenging the carcasses of livestock bearing the sodium fluoroacetate livestock protection collars.<br><br>(b) Mammals<br>The chemical is very highly toxic to mammals on an acute oral basis. Certain species may be exposed, primarily as a result of scavenging the carcasses of livestock bearing the sodium fluoroacetate livestock protection collars. |
| 2,4-D, salts and esters | From 2005 RED for 2,4-D<br>http://www.epa.gov/oppsrrd1/REDs/24d_red.pdf:<br><br>The Agency's level of concern for endangered and threatened freshwater fish and invertebrates, estuarine invertebrates, birds, mammals, aquatic vascular plants, and terrestrial non-target plants is exceeded for the use of 2,4-D. |
| 2,4-DB salts and esters | From 2005 RED for 2,4-DB<br>http://www.epa.gov/oppsrrd1/REDs/0196red_24db.pdf:<br><br>Small and medium mammalian restricted use and Federally listed threatened and endangered species levels of concern were exceeded using the highest application rates for alfalfa. Levels of concern for Freshwater fish were exceeded using the Texas alfalfa scenario by drift and runoff. Levels of concern were exceeded for small and medium size birds feeding on short grass, tall grass, and broadleaf plants/insects when multiple aerial applications are made to alfalfa. |
| 3-chloro-p-toluidine hydrochloride | From 1995 RED for 3-chloro-p-toluidine hydrochloride<br>http://www.epa.gov/oppsrrd1/REDs/2610.pdf:<br><br>Based on toxicity and exposure estimates, starlicide poses a high acute primary risk to nonendangered and endangered birds. Acute risk to both endangered aquatic invertebrates and endangered small mammals also exists. |
| 3-Trifluoro-methyl-4-nitrophenol (TFM) | From 1999 RED for 3-Trifluoro-methyl-4-nitrophenol<br>http://www.epa.gov/oppsrrd1/REDs/3082red.pdf:<br><br>Aquatic acute high risk, acute restricted use, and endangered species LOCs are exceeded for aquatic invertebrates at the typical use rates of TFM. Acute high risk and endangered species LOCs are exceeded for aquatic plants at the typical use rates of TFM. Freshwater fish and aquatic invertebrate endangered species LOCs are exceeded for TFM and niclosamide and aquatic plant endangered species LOCs are exceeded for TFM. |

| | |
|---|---|
| Acephate | From 2006 RED for Acephate<br>http://www.epa.gov/pesticides/reregistration/REDs/acephate_red.pdf:<br><br>Endangered species LOCs except for fish (estuarine and freshwater) and estuarine invertebrates are exceeded for all uses of acephate. In addition, LOCs are exceeded for endangered species of mammals, amphibians, birds, reptiles, insects, and freshwater invertebrates for the degradate methamidophos formed from all uses of acephate. |
| Acetochlor | From 2006 EFED Environmental Risk Assessment for Acetochlor<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648092409c:<br><br>Should exposure occur, EFED expects potential acute risks to endangered freshwater fish. Acute endangered species RQs range from 0.19 to 0.09 for sorghum and sweet corn, respectively.<br><br>Acetochlor use on sweet corn and sorghum exceeds acute risk LOCs for vascular (acute endangered species RQ range from 295 to 590.83) and nonvascular aquatic plants (acute RQ range from 24.76 to 49.58). LOCs are exceeded (RQ range 0.12 to 0.18) for endangered/threatened mammals feeding on short grass in the 15 and 35 gram weight class (Table IV-10). Mammalian chronic LOCs are exceeded for sorghum and sweet corn use patterns with RQs ranging from a high of 4.11 to a low of 1.47 (Table IV-11). |
| Acrolein | From 2008 RED for Acrolein<br>http://www.epa.gov/oppsrrd1/REDs/acrolein_red.pdf:<br><br>The Agency's screening-level assessment indicates a potential for acute risk to listed birds (especially smaller birds) consuming drinking water treated with acrolein at the maximum label rate. For the drinking water only exposure scenario the acute risk LOC for endangered species (RQ>0.1) is exceeded for mammals. There are no data available in order to evaluate the acute toxicity of acrolein to beneficial insects. However, risk is presumed for insects in the absence of data and based on the chemical's mode of action. At the maximum treatment rate of 15 mg/L, acrolein concentrations in the canals exceed acute risk LOCs (RQ>0.5) with RQs of up to 1071 for freshwater fish and up to 2143 for aquatic-phase amphibians. Although aquatic invertebrates are less sensitive than fish and aquatic-phase amphibians to acrolein, the acute risk level of concern (RQ>0.5) for freshwater invertebrates in the canal is >484. As discussed above for the freshwater fish, the highest observed concentration in the monitoring data would also result in an RQ of 2 which is above the Agency's LOC. Based on the toxicity of acrolein to the Eastern oyster, in the canal, the acute RQ is 273 which exceeds the LOC (RQ>0.5) for estuarine/marine invertebrates. In the canal, the acute risk LOC for vascular and non-vascular aquatic plants (RQ>1.0) is exceeded with RQs of 208 and 417, respectively. |

| | |
|---|---|
| Alachlor | From 1998 RED for Alachlor http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0146#documentDetail?R=09000064809240c8:<br><br>A potential risk to nontarget terrestrial and aquatic plants and endangered plant species exists. |
| Aldicarb | From 2007 RED for Aldicarb http://www.epa.gov/pesticides/reregistration/REDs/aldicarb_red.pdf:<br><br>The Agency's screening level risk assessment for endangered and threatened species concluded that use of aldicarb has direct adverse effects on listed species in the following taxonomic groups: terrestrial invertebrates, birds, terrestrial phase amphibians, reptiles, mammals, freshwater fish, freshwater invertebrates, estuarine/marine invertebrates, and estuarine/marine fish. |
| Aluminum and Magnesium Phosphide | From 1998 RED for Al and Mg Phosphide http://www.epa.gov/oppsrrd1/REDs/0025red.pdf:<br><br>One use pattern of aluminum and magnesium phosphide, as a burrow fumigant, poses a risk to threatened and endangered species of mammals and reptiles. The risks posed to these species occur if they are found in a burrow that is fumigated. Because of the high degree of toxicity of phosphine gas, all animals in a treated burrow will be killed.<br><br>In 1981, the United States Fish and Wildlife Service (USFWS) determined that use of aluminum and magnesium phosphide as a burrow fumigant may jeopardize the black-footed ferret, the Utah prairie dog, the San Joaquin kit fox, the blunt-nosed leopard lizard, the eastern indigo snake, and the desert tortoise.<br><br>Aluminum and magnesium phosphide have been subject to a formal consultation with the Fish and Wildlife Service, as noted in Section III of this document. Additional consultation with the Fish and Wildlife Service may be necessary to determine if steps need to be taken to protect newly listed species or from proposed new uses of these pesticides. |
| Ametryne | From 2005 RED for Ametryne http://www.epa.gov/oppsrrd1/REDs/ametryn_red.pdf:<br><br>Acute endangered terrestrial nontarget plant RQs in adjacent and semi-aquatic areas (see Table 19) exceed the LOC for all crops modeled. Endangered species dicot spray drift RQs exceeded the LOC in all uses. Although ametryn is practically nontoxic to mammals on an acute oral exposure basis, screening-level EECs slightly exceed acute restricted use and acute endangered species LOCs for some feed items on several modeled uses. Based on available screening level information there is a potential concern for ametryn's chronic effects on listed |

| | |
|---|---|
| | birds; acute and chronic effects on listed mammals; and effects on listed terrestrial and aquatic plants should exposures actually occur. |
| Aminopyralid, salts and esters | From 2005 Environmental Fate and Ecological Risk Assessment for Aminopyralid http://www.epa.gov/opprd001/factsheets/aminopyralidEFEDRA.pdf:<br><br>Because plant RQs are above non-endangered species LOCs, the Agency considers this to be indicative of a potential for adverse effects to those listed species that rely either on a specific plant species (plant species obligate) or multiple plant species (plant dependent) for some important aspect of their life cycle. The extent to which the use of aminopyralid on wheat and pasture/rangeland will indirectly affect listed animal species will require identification of listed species that co-occur in areas of aminopyralid use and an evaluation of critical habitat as described below. Because of the national extent of the proposed uses of aminopyralid, a "may affect" designation is assumed to be possible for all listed animals. |
| Amitraz | From 1995 RED for Amitraz http://www.epa.gov/oppsrrd1/REDs/0234red.pdf:<br><br>The endangered species LOC (0.10 LD/day) is exceeded for the Carolina wren in the typical and maximum Kenaga scenarios. The endangered species LOC is equaled for the mallard (a grass eater) in the maximum Kenaga scenario. The LOC for high acute risk (0.5) and restricted use (0.2) to mammals have not been exceeded. However, endangered small mammals exposed to areas treated with amitraz may be affected (RQ for endangered species LOC of 0.1). The aquatic EEC for parent amitraz (3.05 ppb) falls short of the restricted use LOC (1/10 LC = 3.5 ppb for daphnia) but surpasses the endangered species LOC (1/20 LC = 1.75 ppb for daphnia). |
| Amitrole | From 1996 RED for Amitrole http://www.epa.gov/oppsrrd1/REDs/0095red.pdf:<br><br>The risk assessment indicates that the use of amitrole may affect endangered mammals and plants. |
| Atrazine | From 2006 RED for Atrazine http://www.epa.gov/oppsrrd1/REDs/atrazine_combined_docs.pdf:<br><br>Endangered species LOCs are exceeded for terrestrial plants, birds and small mammals from the agricultural uses of atrazine. Acute risks to endangered freshwater invertebrates and aquatic vascular plants are exceeded for all crop uses except for the typical use rate on corn (1.1 lb ai/A). Chronic levels of concern for endangered species are exceeded for fish and aquatic invertebrate reproduction for all use rates, except for corn and the typical use rate on sorghum. |

| | |
|---|---|
| Azinphos-Methyl | From 2006 RED for Azinphos-methyl http://www.epa.gov/pesticides/reregistration/REDs/azm_red.pdf:<br><br>OPP has initiated three consultations with the Fish and Wildlife Service (FWS) on the potential effects of azinphos-methyl on endangered and threatened species. To date, the FWS has issued two Biological Opinions. In these Opinions, the FWS found jeopardy for 33 fish species, 31 aquatic invertebrate species, 4 amphibian species, 5 bird species, 4 insect species, and 4 insect pollinated plant species. An additional 7 fish species, 1 amphibian and 1 bird were expected to be affected, but not jeopardized. |
| Benfluralin | From EPA-HQ-OPP-2004-0210-0007 for Benfluralin http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2004-0210%20#documentDetail?R=09000064800b6c87:<br><br>There is cause for concern about reproductive effects in birds and small mammals from labeled uses of benfluralin. However, there are currently no approved models for determining chronic exposure from granular formulations, so we are unable to quantify this risk. Based on some qualitative assumptions, EFED predicts that the potential for chronic risk to birds and small mammals including endangered species from granular application is likely. The chronic levels of concern (LOC) are also exceeded for birds and small mammals feeding on three types of food items when benfluralin is inadvertently sprayed at edges of alfalfa and lettuce fields (transition area). Due to uncertainties in the data, there is reason to believe that potential chronic risk to birds may be greater than calculated. Birds that eat fish may potentially be at risk. Modeled calculations indicate that there may be a potential for reproductive effects in birds that consume fish containing benfluralin residues. However, there is uncertainty in this prediction due to inadequate data.<br><br>The potential for reproductive effects is a concern for freshwater and estuarine fish and invertebrates. Estimated benfluralin concentrations in water 60 days after treatment with granular benfluralin in the range of 9 to 12 lbs ai/acre/season, exceed the chronic endpoint of 1.9 ppb. The potential for these effects from the incorporated uses of benfluralin appear to be unlikely. There is much uncertainty in assessing the potential for acute risk to freshwater fish and invertebrates due to uncertainties in the toxicity data stemming from variability in test concentrations as well as tests conducted above the solubility limit of the compound. Nevertheless, the PRZM-EXAMS model predicts environmental concentrations that are above the predicted endangered species LOC of 5 ppb (0.05 x 100 ppb) for fish and aquatic invertebrates. |

| | |
|---|---|
| Bensulide | From 2006 IRED for Bensulide<br>http://www.epa.gov/pesticides/reregistration/REDs/2035ired.pdf:<br><br>In general, the acute levels of concern for bensulide are exceeded for freshwater fish, including those for threatened or endangered species, and for freshwater invertebrates. |
| Bentazon and salts | From 1994 RED for Bentazon<br>http://www.epa.gov/oppsrrd1/REDs/0182.pdf:<br><br>Acute LOCs were exceeded for endangered birds and mammals based on preliminary EEC values. Endangered true terrestrial and semi-aquatic terrestrial plants occurring adjacent to, or receiving runoff from, areas treated with sodium bentazon may be affected. |
| Brodifacoum | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED)<br>http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA believes that widespread exposures to second-generation anticoagulants (brodifacoum, difethialone, bromadiolone) are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide.<br><br>In March 2005, EPA initiated informal consultation for the nine rodenticides registered at that time. Several reported incidents have involved Federally listed threatened and endangered species, for example the San Joaquin kit fox and Northern spotted owl, in addition to the Bald eagle, which is protected under the Bald and Golden Eagle Act. The FWS issued a biological opinion on eight of the rodenticides in 1993. The USFWS in 1993 determined that brodifacoum would put 10 mammalian species and two bird species in jeopardy.<br><br>EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Secondary exposure to the second-generation anticoagulants is particularly problematic due to these |

| | |
|---|---|
| | compounds' high toxicity and long persistence in body tissues (e.g., liver retention half-lives of greater than 300 days). The second- generation anticoagulants are designed to be toxic in "a single night's feeding," but since time to death is 5-7 days, the target rodent can feed multiple times before death, leading to a carcass containing residues that may be many times the lethal dose. Additionally, the extended persistence of second-generation anticoagulants in the body of a predator or scavenger can result in adverse effects from additive exposures through multiple feedings that are separated by days or weeks. |
| Bromacil and salts | From 1996 RED for Bromacil http://www.epa.gov/oppsrrd1/REDs/0041red.pdf:<br><br>Based on the RQs calculated using the GENEEC model, use patterns with an application rate of 32 lbs a.i./A for the granular formulation (rights-of-way, non-agricultural uncultivated, and industrial outdoors), and an application rate of 24 lbs a.i./A for both liquid and granular formulations, exceed the acute endangered species LOC for freshwater fish and amphibians. The endangered freshwater fish acute LOC was exceeded for all use patterns for both liquid and granular formulations. Endangered species acute LOCs have been exceeded for birds, mammals, aquatic organisms, and plants. |
| Bromadiolone | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED) http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA believes that widespread exposures to second-generation anticoagulants (brodifacoum, difethialone, bromadiolone) are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide.<br><br>In March 2005, EPA initiated informal consultation for the nine rodenticides registered at that time. Several reported incidents have involved Federally listed threatened and endangered species, for example the San Joaquin kit fox and Northern spotted owl, in addition to the Bald eagle, which is protected under the Bald and Golden Eagle Act. The FWS issued a biological opinion on eight of the rodenticides in 1993. The USFWS in 1993 determined that bromadiolone would put seven mammalian species in jeopardy.<br><br>EPA's comparative ecological risk assessment concludes that each of the |

| | |
|---|---|
| | rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Secondary exposure to the second-generation anticoagulants is particularly problematic due to these compounds' high toxicity and long persistence in body tissues (e.g., liver retention half-lives of greater than 300 days). The second- generation anticoagulants are designed to be toxic in "a single night's feeding," but since time to death is 5-7 days, the target rodent can feed multiple times before death, leading to a carcass containing residues that may be many times the lethal dose. Additionally, the extended persistence of second-generation anticoagulants in the body of a predator or scavenger can result in adverse effects from additive exposures through multiple feedings that are separated by days or weeks. |
| Bromethalin | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED) http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Although the non-anticoagulant rodenticides appear to be much less hazardous to secondary consumers, confirmatory data are still needed to make this assumption for bromethalin and cholecalciferol baits.<br><br>From 1998 RED for rodenticides: http://www.epa.gov/oppsrrd1/REDs/2100red.pdf<br><br>Because bromethalin is a rodenticide, risk is presumed for any small mammals that feed on the bait. Bromethalin is very highly toxic to aquatic organisms, but its use in and around buildings, cargo vessels, alleys, and sewers is likely to result in minimal contamination of aquatic environments. The U. S. Fish and Wildlife Service addressed Bromethalin in its Biological Opinion issued in March of 1993. The use patterns included control of Norway rats, roof rats and house mice in and around homes, commercial, industrial and agricultural buildings and airports, landing strips and urban alleys. The USFWS in 1993 determined that bromethalin would put 10 mammalian species in jeopardy. |

| | |
|---|---|
| Bromoxynil, salts and esters | From 1998 RED for Bromoxynil http://www.epa.gov/oppsrrd1/REDs/2070red.pdf:<br><br>The use of bromoxynil octanoate may adversely effect endangered species of birds and mammals, both acutely and chronically; fish and invertebrates (both freshwater and estuarine/marine species) acutely; and terrestrial, semi-aquatic, and aquatic nonvascular plants. |
| Butralin | From 1998 RED for Butralin http://www.epa.gov/oppsrrd1/REDs/2075red.pdf:<br><br>The following endangered species LOCs have been exceeded: herbivorous and insectivorous endangered mammals and freshwater aquatic invertebrates, and estuarine/marine fish and shrimp. Also, there may be possible reproductive effects to birds. |
| Captan | From 1999 RED (2004 amendment) for Captan http://www.epa.gov/oppsrrd1/REDs/0120red.pdf:<br><br>With multiple applications, the acute endangered species LOC is exceeded for turf use, as is the chronic risk for herbivores and insectivores. Foliar turf applications and air blast applications to fruit and nut crops (except cherries) are expected to exceed high acute risk, restricted use, and endangered species LOCs for fish. LOCs are exceeded for endangered species of freshwater invertebrates for turf, almonds and peaches. |
| Carbaryl | From EPA-HQ-OPP-2003-0101-0005 (2003 Revised EFED risk assessment of carbaryl) http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064800b5022:<br><br>Carbaryl is not likely to represent a risk of acute mortality to birds; however, on the majority of uses modeled, the chronic risk level of concern is exceeded. Based on estimated environmental concentrations, over 75% of the registered uses modeled are likely to represent a risk of acute mortality and chronic growth/reproductive effects in mammals. Carbaryl is also very highly toxic to bees and at current application rates these beneficial insects will likely succumb to acute mortality if they come in direct contact with the chemical in the immediate treatment areas. No acute risk LOCs are exceeded for estuarine/marine fish and carbaryl use on citrus alone exceeds the acute risk LOC for freshwater fish. The acute endangered species LOC is minimally exceeded for all freshwater fish as the magnitude of the risk quotients is low, i.e. < 0.70). Consistent with carbaryl's classification as being very highly toxic to aquatic invertebrates, both acute mortality and chronic reproductive/growth effects are likely for freshwater invertebrates in static bodies of water. |

| | |
|---|---|
| Carbendazim | From 2005 RED for Thiophanate-methyl<br>http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf:<br><br>EPA's ecological risk assessment suggests that Thiophanate-methyl and its primary metabolite carbendazim (methyl 2-benzimidazole carbamate or MBC) is expected to pose a chronic risk to endangered birds, mammals, aquatic animals, and aquatic plants under most of the registered use scenarios. |
| Carbofuran | From 2007 Endangered Species Risk Assessment for Carbofuran<br>http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0146#documentDetail?R=090000648092408a:<br><br>Endangered species acute and chronic LOCs were exceeded for all groups of terrestrial animals (birds, mammals, reptiles, amphibians, and invertebrates) for all uses and for all rates of flowable and granular formulations of carbofuran. Endangered species acute and chronic LOCs were also exceeded for all groups of aquatic organisms for most uses of flowable and the limited remaining granular formulations of carbofuran. Exceptions were for mollusks and for carbofuran uses on alfalfa and grapes. |
| Carboxin | From 2004 RED for Carboxin<br>http://www.epa.gov/oppsrrd1/REDs/0012red_carboxin.pdf:<br><br>Acute risk LOCs for endangered/threatened mammals are exceeded for onions (RQ = 0.24) and cotton (RQ = 0.12) based on maximum seed application rate. Chronic risk LOCs have been exceeded for both avian (RQ range 2.5 to 27) and mammalian species (RQ range: 0.51 to 5.5). |
| Chlorantraniliprole | From 2007 Environmental Risk Assessment for Chlorantraniliprole<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a14538:<br><br>Direct and indirect effects on terrestrial and semi aquatic plants - monocots and dicots, freshwater crustaceans, and mollusks. Direct effects on terrestrial invertebrates and marine/estuarine invertebrates. Indirect effects on birds, terrestrial phase amphibians, reptiles, mammals, freshwater fish, aquatic phase amphibians, and marine/estuarine fish. |
| Chlorophacinone | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED)<br>http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and |

| | |
|---|---|
| | secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. The USFWS in 1993 determined that chlorophacinone would put 20 mammalian species and one bird species in jeopardy.<br><br>From 1998 RED for chlorophacinone http://www.epa.gov/oppsrrd1/REDs/2100red.pdf:<br><br>Based on maximum EECs for a single application, the avian acute high risk, restricted use, and endangered species, LOCs are exceeded for birds feeding on short grass. Restricted use and endangered species LOCs are exceeded for insectivores. Based on mean EECs, restricted use and endangered species, LOCs are exceeded for short grass. Moreover, the endangered species LOC is exceeded for birds feeding on small insects. Because rodents, moles (insectivores), and jackrabbits (lagomorphs) are target species and chlorophacinone is very highly toxic to small mammals, the Agency presumes acute high risk to any small mammals that feed on chlorophacinone baits or sprayed food items (e.g., grass, seeds, insects) over a period of several days. |
| Chloropicrin | From EPA-HQ-OPP-2009-0081-0008-Effects Determination for CA Red-legged Frog) http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480924079:<br><br>(Toxicity of Chloropicrin to CA Red-legged Frog (CRLF)) NOTE: Toxicity to amphibians is not directly evaluated by U.S. EPA; instead, the Agency uses fish toxicity data to estimate toxicity to the aquatic life stage and bird or mammal toxicity data to estimate toxicity to the terrestrial life stage. A determination of exceedance of LOCs for the aquatic or terrestrial phases of the CRLF indicates that concentrations in the environment exceed LOCs for fish or birds or mammals.<br><br>The best available data suggest that chloropicrin is likely to adversely affect the CRLF due to the potential for direct toxicity to aquatic and terrestrial phases of the frog, as well as the potential for indirect effects to food supply, habitat and designated Critical Habitat.<br><br>The acute toxicity of chloropicrin to freshwater fish was evaluated in rainbow trout and bluegill sunfish, with LC50 values of < 16.98 ppb (very highly toxic) and < 105 ppb (at least highly toxic), respectively. The acute toxicity of chloropicrin to aquatic invertebrates has been assessed in Daphnia pulex, with a 48-hour LC50 value of < 71 ppb (very highly toxic). Based on the results of an acute oral toxicity study in rats (Table 4.2), chloropicrin is highly toxic to mammals. An assumption of equivalent sensitivity between birds and mammals for exposure through inhalation is being employed. For fish (surrogate for aquatic-phase CRLF), risk quotients are considered to exceed the endangered |

| | |
|---|---|
| | species acute LOC (0.05) for five of the nine California-specific scenarios used. For aquatic invertebrates (food for aquatic-phase CRLF), risk quotients are considered to exceed the aquatic acute endangered species LOC (0.05) for four of the nine California- specific scenarios used. |
| Chlorothalonil | From 1999 RED for Chlorothalonil http://www.epa.gov/oppsrrd1/REDs/0097red.pdf:<br><br>The registered uses of chlorothalonil may adversely affect endangered species of birds (chronically), mammals (chronically), freshwater fish (acutely and chronically), freshwater invertebrates (acutely) and aquatic plants. Mollusks which may be at risk include freshwater mussels (a phylum that includes numerous freshwater endangered species). |
| Chlorpyrifos | From Supplemental CD, 2000 EFED Assessment Part 4 for Chlorpyrifos:<br><br>Endangered species LOCs are exceeded for small mammals, birds, freshwater fish and invertebrates, and estuarine fish and invertebrates for most chlorpyrifos uses. Chlorpyrifos is used widely throughout the country with a large number of crop and non-crop uses with residues found in 26 percent of fish sampled from 314 monitoring sites. Hence, there is high potential for many endangered and threatened species to be exposed to chlorpyrifos. |
| Cholecalciferol | From EPA-HQ-OPP-2006-0955-0005 for Cholecalciferol http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064801f4cf6:<br><br>Rodenticide baits are formulated to be lethal to small mammals, and they are not selective to the target species. All baits pose a high potential primary risk to nontarget mammals that eat bait. The USFWS in 1993 determined that cholecalciferol would put 10 mammalian species in jeopardy. |
| Clodinafop-propargyl | From 2000 Fact Sheet for Clodinafop-propargyl http://www.epa.gov/opprd001/factsheets/clodinafop.pdf:<br><br>Based on the estimated environmental concentrations (EECs) of clodinafop-propargyl and its acid metabolite, CGA-193469, the use of Discover™ Herbicide is not expected to pose a risk to non-target organisms, with the exception of non-target plants. |
| Clothianidin | From 2003 Fact Sheet for Clothianidin http://www.epa.gov/opprd001/factsheets/clothianidin.pdf:<br><br>Clothianidin is expected to present acute and/or chronic toxicity risk to endangered/threatened birds and mammals via possible ingestion of treated corn and canola seeds. Endangered/threatened non-target insects may be impacted via |

| | |
|---|---|
| | residue laden pollen and nectar. |
| Copper and zinc naphthenate | From EPA-HQ-OPP-2007-0589-0008 for Naphthenate Salts http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006 48026bcfa:<br><br>LOCs were exceeded for freshwater fish and freshwater invertebrates in bodies of water 6 acre-feet in size. |
| Creosote | From 2008 RED for Creosote http://www.epa.gov/oppsrrd1/REDs/creosote_red.pdf:<br><br>The level of concern (LOC) is exceeded for acute risk to listed (i.e., endangered and threatened) freshwater and saltwater (estuarine/marine) fish and aquatic invertebrates as well as nonlisted saltwater invertebrates exposed to PAHs in the water column and/or aquatic sediment. |
| Cycloate | From 2004 RED for Cycloate http://www.epa.gov/oppsrrd1/REDs/cycloate_red.pdf:<br><br>The screening level risk assessment indicates that cycloate exceeds the endangered species level of concern for chronic risks to mammals. |
| Cypermethrin isomer mixtures | From 2008 Revised RED for Cypermethrin http://www.epa.gov/oppsrrd1/REDs/cypermethrin_revised_red.pdf:<br><br>LOCs for acute risk (0.5) and acute endangered species risk (0.05) are exceeded for freshwater and estuarine/marine invertebrates for all six crop scenarios considered in this assessment. For mammals, the acute endangered species LOC (0.1) is exceeded for 15g and 35g mammals feeding on short grass (dose-based RQs 0.1-0.2) for all crop scenarios and aquatic organisms (LOC = 0.05) were exceeded. |
| Dazomet | From 2009 amended RED for Dazomet http://www.epa.gov/oppsrrd1/reregistration/REDs/dazomet-red-amended.pdf:<br><br>The Agency's levels of concern are exceeded for acute oral consumption of dazomet granular product for both mammal and bird species that are not Federally-listed as endangered or threatened as well as for 'listed' species. |
| DCPA | From 1998 RED http://www.epa.gov/oppsrrd1/REDs/0270red.pdf:<br><br>Ecological effects risk assessments indicate that there may be a concern for endangered mammals and mollusks exposed to DCPA. Residues on short grass when divided by the meadow vole LC50 do result in a risk quotient which |

| | |
|---|---|
| | exceeds the LOC (0.2) for restricted use. LOCs for endangered mollusk species were exceeded for all use scenarios. |
| DDVP (dichlorvos) | From 2006 RED for DDVP http://www.epa.gov/pesticides/reregistration/REDs/ddvp_red.pdf:<br><br>The Agency's levels of concern for endangered and threatened freshwater invertebrates, birds, and mammals are exceeded for dichlorvos use. |
| Diazinon | From 2006 RED for Diazinon http://www.epa.gov/pesticides/reregistration/REDs/diazinon_red.pdf:<br><br>Endangered species LOCs are exceeded for multiple taxonomic groups of organisms on most application sites. The USFWS has determined that diazinon is likely to jeopardize multiple aquatic and terrestrial species. In 1989 the USFWS issued a biological opinion on diazinon in response to EPA's request for consultation. Given the evaluation criteria, a total of 132 species (5 bird, 6 amphibian, 77 fish, 32 mussel, 6 crustacean, 4 miscellaneous aquatic invertebrates, and 2 snake) were considered potentially affected by the use of diazinon. |
| Dicamba and salts | From 2006 RED for Dicamba http://www.epa.gov/oppsrrd1/REDs/dicamba_red.pdf:<br><br>Chronic RQs exceeded LOCs for endangered mammals at all application rates modeled. Acute LOCs were exceeded for endangered birds at all application rates. LOCs were exceeded for terrestrial plants adjacent to treated areas and in semi-aquatic areas at all application rates. |
| Dichlobenil | From 1998 RED for Dichlobenil http://www.epa.gov/oppsrrd1/REDs/0263red.pdf:<br><br>With unincorporated application, the LOC for effects to small endangered mammals are exceeded at a use rate of 20 lbs ai/A. RQs for unincorporated applications at 20 lbs ai/A exceed the LOC for effects to endangered fish. The LOC for potentially high acute risk to mollusks is exceeded for unincorporated applications at 20 lb ai/A. The restricted use LOC is exceeded by unincorporated applications at 6 lbs ai/A, and incorporated applications at 20 lbs ai/A. Unincorporated applications at 4 lbs ai/A and higher and incorporated applications at 6 lbs ai/A and higher are considered to exceed the endangered mollusks species LOC. Unincorporated applications at 20 lbs ai/A exceed the LOC for effects to endangered aquatic invertebrates. Dichlobenil is also expected to affect endangered species of terrestrial and semi-aquatic plants. Ground-feeding endangered birds may be affected at all use rates if these birds ingest the larger granules, especially the 10G formulations. |

| | |
|---|---|
| Dichloran (DCNA) | From 2006 RED for Dichloran http://www.epa.gov/oppsrrd1/REDs/dcna_red.pdf:<br><br>Endangered species LOCs are exceeded for birds for many of the uses in this screening- level assessment (RQs range from 0.1 to 2.49). The assessment indicates that DCNA has the potential to affect listed freshwater fish, birds, and mammals should exposures occur at the estimated levels. |
| Dichlorprop-P, salts and esters (2,4-DP-P) | From 2007 RED for Dichlorprop-P http://www.epa.gov/oppsrrd1/REDs/24dp_red.pdf:<br><br>The acute endangered RQ exceeded the LOC of 0.1 for acute risk to birds. The dietary-based chronic RQs for birds exceed the Agency's LOC of 1 for most food items, which applies to both non-endangered and endangered species. Mammalian acute and chronic RQs exceeded the LOCs for some food items based on both spray and granular applications at the maximum application rate of 6.0 lbs ae 2,4-DP-p/A. As expected with an herbicide, the acute LOCs (LOC of 1 for plants) were exceeded for endangered and non-endangered terrestrial and semi- aquatic plants located adjacent to treated areas, both as a result of combined runoff and spray drift, and from spray drift alone for 2,4-DP-P. |
| Diclofop-methyl | From 2000 RED for Diclofop-methyl http://www.epa.gov/oppsrrd1/REDs/2160red.pdf:<br><br>Because RQs for all food types (with the exception of seeds) exceeds the chronic LOC (1.0), all uses of diclofop-methyl may pose chronic risk to mammals, and may pose a risk to threatened as well as endangered mammalian species. |
| Dicofol | From 1998 RED for Dicofol http://www.epa.gov/oppsrrd1/REDs/0021red.pdf:<br><br>The endangered species level of concern from the use of dicofol is exceeded for fish and aquatic invertebrates at all label application rates; for birds at application rates greater than 0.75 lb a.i./acre, and for mammals at application rates greater than 0.4 lb a.i./acre. |
| Dicrotophos | From 2006 RED for Dicrotophos http://www.epa.gov/pesticides/reregistration/REDs/dicrotophos_red.pdf:<br><br>Endangered species LOCs are exceeded for acute and chronic risks to birds, mammals and freshwater and estuarine invertebrates. |
| Difenacoum | Difenacoum was not specifically addressed in the rodenticide cluster assessments because it has only been registered since 2007. It is a second-generation rodenticide that has similar toxicity to the other second generation rodenticides brodifacoum, bromadiolone, and difenacoum. |

| | |
|---|---|
| | From EPA-HQ-OPP-2006-0955-0762 for Difenacoum http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648060c4c6:<br><br>Difenacoum is expected to impose risks to listed birds and mammals, and also to reptiles and terrestrial phase amphibians. Indirect effects are expected to these same taxa as a result of the loss of avian, mammalian, reptilian, and amphibian prey items. According to the studies reviewed in the difenacoum dossier, difenacoum is very highly toxic to freshwater animals and has been shown to reduce population growth in freshwater algae. |
| Difethialone | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED) http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA believes that widespread exposures to second-generation anticoagulants (brodifacoum, difethialone, bromadiolone) are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide.<br><br>EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Secondary exposure to the second-generation anticoagulants is particularly problematic due to these compounds' high toxicity and long persistence in body tissues (e.g., liver retention half-lives of greater than 300 days). The second- generation anticoagulants are designed to be toxic in "a single night's feeding," but since time to death is 5-7 days, the target rodent can feed multiple times before death, leading to a carcass containing residues that may be many times the lethal dose. Additionally, the extended persistence of second-generation anticoagulants in the body of a predator or scavenger can result in adverse effects from additive exposures through multiple feedings that are separated by days or weeks. |

| | |
|---|---|
| Diflubenzuron | From 1997 RED for Diflubenzuron<br>http://www.epa.gov/oppsrrd1/REDs/0144red.pdf:<br><br>Acute and chronic LOCs for endangered species are exceeded for freshwater and estuarine/marine aquatic invertebrates for the citrus, cotton and forestry usage groups. A chronic LOC was exceeded for estuarine/marine fish for the highest forestry use rate (0.13 lb ai/A). The acute LOC for estuarine/marine mollusks was exceeded for the three highest forestry use rates. |
| Dimethenamid and isomers | From EPA-HQ-OPP-2009-0081-0021, Ecological Risk Assessment for Dimethenamid<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480924086:<br><br>This screening risk assessment indicates that there are exceedances of the LOCs for endangered non-vascular and vascular aquatic plants. At the application rate of 0.98 lb ai/A and the use of dimethenamid on ornamentals at the application rate of 1.5 lb ai/A, the LOC is exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of a combination of runoff and drift from ground and aerial applications. For the maximum application rate of 1.5 lb ai/A (2 applications) and maximum predicted residue levels, the Acute Endangered Species LOC is exceeded for 20 g birds foraging on short grass, tall grass, and broadleaf forage/small insects and for 100 g birds foraging on short grass, tall grass and broadleaf forage/small insects and for 1000 g birds foraging on short grass. Avian risk data indicates that terrestrial phase amphibians and reptiles may be at risk to adverse effects to survival and growth from the acute oral exposure to s-dimethenamid as a result of consuming contaminated feed items or ingesting fertilizer impregnated granules at proposed application rates. At both application rates (0.98 and 1.5 lb ai/A) and maximum predicted residue levels, the dose-based RQs exceeded the Chronic Risk and Endangered Species LOCs for all weight classes of mammals (15, 35, 1000 g) consuming short grass, tall grass, and broadleaf forage/small insects. |
| Dimethoate | From 2007 revised IRED for Dimethoate<br>http://www.epa.gov/pesticides/reregistration/REDs/dimethoate_ired_revised.pdf :<br><br>The Agency's preliminary risk assessment for endangered species indicates that RQs exceed the endangered species LOC for birds and mammals.<br><br>From 2006 Supplement to the Dimethoate Ecological Risk Assessment, EPA-HQ-OPP-2005-0084-0040<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480199bf6:<br><br>Spatially limited monitoring data indicate that dimethoate is found in large rivers |

| | |
|---|---|
| | and reservoirs. Monitoring conducted in the main stem of the San Joaquin River near Sacramento, California, reveals peak dimethoate concentrations of 2.4 µg/L.At this concentration, the acute risk to endangered species level of concern is exceeded for freshwater invertebrates.<br><br>Endangered species LOCs are exceeded for terrestrial animals across most of the uses evaluated. At the application rates evaluated for dimethoate acute and chronic risk to endangered species LOCs are exceeded for terrestrial animals across all uses. After a single application of 0.16 lbs a.i./A, the endangered species acute risk LOC is just exceeded for birds (RQ=0.12) and is exceeded by a factor of roughly 3X for mammals feeding on short grasses. Chronic risk LOCs are exceeded by factors ranging as high as 9.6X for birds and 167X for mammals based on maximum residue values following a single application of 0.16 lbs<br><br>From 2008 ES Risk Assessment for endangered salmon, http://www.epa.gov/oppfead1/endanger/litstatus/effects/dimethoate/dimethoate_analysis.pdf:<br><br>EPA also consulted with the National Marine Fisheries Service concerning dimethoate effects on endangered salmon and steelhead. In its assessment, the Agency determined that the use of dimethoate may affect 19 salmon and steelhead evolutionarily significant units (ESUs), may affect but is not likely to adversely affect two ESUs and will have no effect on four ESUs. |
| Diphacinone and its sodium salt | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED) http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. The USFWS in 1993 determined that diphacinone would put 28 mammalian species and one bird species in jeopardy.<br><br>From 1998 RED for diphacinone:<br><br>Potential secondary risks exist for some avian predators and scavengers that feed on poisoned rodents. The Agency presumes acute high risk to any small mammals that feed on diphacinone baits. |

| | |
|---|---|
| Diquat dibromide | From EPA-HQ-OPP-2009-0846-0007, Registration Review Problem Formulation for Diquat dibromide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a67821:<br><br>Potentially direct adverse effects to terrestrial and aquatic plants. Diquat is expected to directly pose a significant risk to aquatic animals, and may also affect animals indirectly from lower dissolved oxygen as a result of decomposing plant matter. |
| Diuron | From 2001 EFED risk assessment for RED for Diuron http://www.epa.gov/oppfead1/endanger/litstatus/effects/diuron_efed_chapter.pdf:<br><br>Based on the likelihood of environmental exposure and high RQ values, diuron poses potential risk to terrestrial and aquatic animals and nontarget terrestrial and aquatic plants. For animals, the acute RQ values based on the maximum exposures are as follows: mammals (1.19- 9.22), avian (<1.16), and aquatic animals (1.35-9.00). For plants, the acute RQ values ranged from 1.25-76.5, and the endangered species RQ values ranged from 6.5-306. No avian chronic data are available, but exposure and risk are expected to be high because of diuron's persistence in environment. Finally, environmental monitoring studies have routinely confirmed diuron residues at occasional high concentrations in both surface and ground water. OPP's Ecological Incident Information System (EIIS) summary report confirmed 29 cases of incidents involving nontarget organism that occurred mostly in the 1990's. Of the 29 incidents, one included birds, 16 involved fish, and 12 involved plants. EFED believes that the reported incidents are only a subset of the total number of incidents that are likely occurring because of uncertainty due to spacial and temporal variation of monitoring studies and voluntary incident reporting. |
| Endosulfan | From 2007 RED for Endosulfan http://www.epa.gov/oppsrrd1/REDs/endosulfan_red.pdf:<br><br>Endangered species LOCs are exceeded for acute and chronic risks to all taxa for endangered/threatened animals – birds, mammals, fish, aquatic invertebrates, amphibians, reptiles and terrestrial for all currently registered uses of endosulfan. |
| Endothall and salts | From 2005 RED for Endothall http://www.epa.gov/oppsrrd1/REDs/endothall_red.pdf:<br><br>Acute threatened and endangered species LOCs are exceeded in the screening level risk assessment for freshwater fish (RQs range from 12 to 119), estuarine/marine fish (RQs range from .6 to 6.10), freshwater invertebrates (RQs range from 6 to 417), estuarine/marine invertebrates (RQs range from 3.10 to 31.10), freshwater endangered vascular plants (RQs range from 3 to 33), and freshwater algae (RQs range from 217 to 2174) from all direct applications to |

| | |
|---|---|
| | water, including once-through cooling tower uses. Chronic threatened and endangered LOCs are exceeded for freshwater fish (RQs range from 2.2 to 22.2) and invertebrates (RQs range from 133 to 1331.3) from all direct applications to water, including once- through cooling tower uses. |
| EPTC | From 1999 RED for EPTC http://www.epa.gov/oppsrrd1/REDs/0064red.pdf:<br><br>The Agency has identified the following endangered and threatened species groupings as potentially at risk from EPTC uses: small mammalian herbivores, small mammalian insectivores and terrestrial plants. In consultations with the U.S. Fish and Wildlife Service in 1983-84 for the Forestry "cluster" and again in 1989 in a re-initiation on "clusters", jeopardy to some plants were identified in both consultations for EPTC. |
| Ethalfluralin | From 1995 RED for Ethalfluralin http://www.epa.gov/oppsrrd1/REDs/2260.pdf:<br><br>Endangered species levels of concern are exceeded for freshwater organisms and estuarine/marine invertebrates from unincorporated applications; for freshwater fish from incorporated applications; and for plants growing in wet areas receiving channelized runoff from treated sites (from unincorporated applications). |
| Ethephon | From 1995 RED for Ethephon http://www.epa.gov/oppsrrd1/REDs/0382.pdf:<br><br>No detrimental effects are expected for any endangered animal. However, some uses of ethephon may harm certain endangered plants that live in wet areas. |
| Ethofumesate | From 2005 RED for Ethofumesate http://www.epa.gov/oppsrrd1/REDs/ethofumesate_red.pdf:<br><br>The screening level risk assessment for endangered species indicates that ethofumesate RQs exceed the endangered species LOCs for the following combinations of analyzed uses and species: Freshwater fish (direct acute effects) based on predicted EECs for runoff from terrestrial use of ethofumesate on sugar beets, turf, and vegetables, and terrestrial plants (direct effects) based on predicted EEC for the terrestrial use of ethofumesate on sugar beets, turf, and vegetables for both monocots and dicots. |
| Ethoprop | From 2006 IRED for Ethoprop http://www.epa.gov/pesticides/reregistration/REDs/ethoprop_ired_combined.pdf:<br><br>Endangered species LOCs for ethoprop are exceeded for birds, mammals, and both freshwater fish and invertebrates and estuarine fish. The risk assessments for aquatic vertebrates assume that amphibians exhibit similar toxicity profiles to the |

| | |
|---|---|
| | toxicity data which are available for fish. In addition, the risk assessments also make the assumption that avian and reptilian toxicity are similar. |
| Famoxadone | From 2003 Fact Sheet for Famoxadone http://www.epa.gov/opprd001/factsheets/famoxadone.pdf:<br><br>Based on a screening level analysis, the Endangered Species LOC and Acute Restricted Use LOC for freshwater fish and invertebrates are slightly exceeded. Based on a screening level analysis, the Endangered Species LOC for estuarine/marine fish was exceeded for Florida tomatoes, Florida peppers, and Maine potatoes. The Endangered species LOC and Acute Restricted Use LOC for estuarine/marine invertebrates was exceeded in all scenarios. Chronic RQs for herbivorous birds, insectivorous birds and herbivorous mammals exceeded the LOCs from exposure to famoxadone residues in wildlife food items indicating potential for chronic risks. The Agency has concerns with the potential for negative impacts on endangered insects. |
| Fenbutatin-oxide | From 1994 RED for Fenbutatin-oxide http://www.epa.gov/oppsrrd1/REDs/0245.pdf:<br><br>Acute risk to endangered birds and mammals is not expected from any of the current uses. There is a potential for chronic hazard to these organisms from the use of fenbutatin-oxide at current rates. Acute risk to endangered freshwater fish and invertebrates is expected from all major uses. |
| Fenoxycarb | From EPA-HQ-OPP-2006-0111-0003, Registration Review Problem Formulation for Fenoxycarb http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648026d31c:<br><br>Risks are likely to exceed the Agency's LOC for listed and non-listed species for: chronic risk to freshwater and estuarine/marine invertebrates. Risks are unable to be determined due to lack of data for acute and chronic risk to terrestrial and aquatic plants, and for chronic risk to birds and mammals. |
| Fentin hydroxide (TPTH) | From 1999 RED for Fentin hydroxide http://www.epa.gov/oppsrrd1/REDs/0099red.pdf:<br><br>Endangered and threatened avian species may be at acute and chronic risk from applications of TPTH. There were no acute risks to endangered and threatened mammalian species associated with single applications of TPTH but risks from multiple applications were associated with the pecan use. Endangered and threatened mammalian species may be at chronic risk from most single and all multiple applications of TPTH. Endangered and threatened freshwater fish, freshwater invertebrates, estuarine/marine fish and especially mollusks may be at acute risk from TPTH. Also, endangered and threatened freshwater fish and |

| | |
|---|---|
| | invertebrates may be at chronic risk from TPTH. Chronic risk to endangered and threatened estuarine/marine fish and invertebrates is unknown due to a lack of data, although risk would likely be present due to high toxicity of the compound to aquatic organisms in general and extrapolation from freshwater data. |
| Ferbam | From 2005 RED for Ferbam http://www.epa.gov/oppsrrd1/REDs/ferbam_red.pdf:<br><br>All chronic RQs for all uses exceeded LOCs for endangered birds and mammals under both single applications (RQs for birds ranged from 5 to 400 and for mammals they ranged from 1.5 to 137) and multiple applications (RQs for birds ranged from 5 to 700 and for mammals they ranged from 1.5 to 228). Since there were risks to endangered birds and fish, risk to endangered reptiles and amphibians is also possible, should exposure actually occur. |
| Fluazinam | From 2001 Fact Sheet for Fluazinam http://www.epa.gov/opprd001/factsheets/fluazinam.pdf:<br><br>The risk assessment suggests that exposure of this compound to fish (freshwater and estuarine/marine) through the proposed use patterns (peanuts and potatoes) can result in acute (restricted use and endangered species concern category) and chronic risk. Exposure to aquatic invertebrates (freshwater and estuarine/marine) from peanut use can result in acute risk (restricted use and endangered species concern category). No acute or chronic exceedences are expected for freshwater invertebrates from the potato use. Chronic exposure to estuarine/marine fish and invertebrates could not be calculated at this time because of a lack of appropriate data. Although acute exposure should result in minimal toxic effects to birds, the risk assessment suggests that the proposed uses can cause chronic (reduced growth in young) effects in birds. RQ values were calculated for exposure to peanuts (maximum EECs RQ = 1.0 - 1.8 and 56 day average EECs RQ = 1.1 ppm) and potatoes (maximum EECs RQ = 1.0 - 1.5 and 56 day average(RQ = 1). The risk assessment suggests that the proposed uses can result in chronic risk to mammalians (herbivores and insectivores). RQ values were calculated for exposure to peanuts (maximum EECs RQ = 1.6 - 3.5 and 56 day average EECs RQ = 1.0 - 2.2) and potatoes (maximum EECs RQ = 1.0 - 1.9 and 56 day average EECs RQ = 1.4 - 3.0). Acute concerns appear to be focused on grass eating endangered mammals (RQ = 0.1) |
| Flubendiamide | From 2008 EFED Risk Assessment for Flubendiamide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064806d8db1:<br><br>Aquatic and terrestrial invertebrates (non-target Lepidoptera species and beetles) were identified as being of potential concern for direct effects for listed species for the proposed uses (Table 1). There is potential for flubendiamide to exert indirect effects upon the listed organisms by for example, perturbing forage or |

| | |
|---|---|
| | prey availability, altering pollination and/or dispersal, etc. [Indirect effects in Table 1 are flagged for terrestrial and semi-aquatic plants--monocots and dicots; birds, amphibians, reptiles, mammals, freshwater fish and invertebrates.] |
| Flumetralin | From EPA-HQ-OPP-2007-0990-0008 for Flumetralin http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064807d736e:<br><br>The LOC for direct acute effects to listed freshwater fish (and aquatic-phase amphibians) is exceeded. Although there are no data regarding the chronic effects to estuarine/marine animals, acute-to-chronic ratio analysis suggests potential risk to these organisms will be low. Risk is presumed for aquatic non-vascular plants in the absence of data. The potential for acute risk to birds and mammals appears to be low. There is potential for chronic risk to mammals, and chronic risk to birds, terrestrial-phase amphibians and reptiles is presumed in the absence of avian chronic toxicity data. Sensitive terrestrial pant species may be adversely affected by drift over 100 feet from the edge of field. Indirect effects to terrestrial or aquatic wildlife cannot be ruled out due to the potential for flumetralin to affect terrestrial and semi-aquatic plants which may lead to changes in food supply or habitat. |
| Fluometuron | From 2005 RED for Fluometuron http://www.epa.gov/oppsrrd1/REDs/fluometuron_red.pdf:<br><br>All acute non-endangered and endangered RQs for non-target terrestrial and semi-aquatic plants are greater than the LOC of 1. Acute RQs for birds feeding on short grass, tall grass, broadleaf plants, and small insects slightly exceed the Agency's acute endangered species LOC of 0.1 Acute RQs based on maximum EECs for smaller mammals feeding on short grass slightly exceed the Agency's acute LOC of 0.5. Acute RQs for smaller mammals feeding on short grass, tall grass, broadleaf plants, and insects, and large mammals feeding on short grass exceed the Agency's endangered species acute LOC of 0.1. All chronic mammalian RQs exceed the Agency's chronic LOC of 1. Acute RQs for freshwater fish based on EECs modeled for Mississippi and freshwater invertebrates based on EECs modeled for Mississippi, Texas, and North Carolina slightly exceed the Agency's acute LOC of 0.5. Acute RQs for freshwater fish and freshwater invertebrates for all locations modeled exceed the Agency's endangered species LOC for aquatic animals of 0.05. For endangered species, the predicted RQs are equal to or slightly exceed the LOC of 0.05 for aquatic animals based on peak EECs modeled for Mississippi, Texas, and North Carolina. |
| Fluoxastrobin | From 2005 Fact Sheet for Fluoxastrobin http://www.epa.gov/opprd001/factsheets/fluoxastrobin.pdf:<br><br>The preliminary risk assessment for endangered species indicates that fluoxastrobin exceeds the endangered species LOCs for the following |

| | |
|---|---|
| | combinations of analyzed uses and species.<br>• Use of fluoxastrobin on the following crop scenarios indicate an exceedance of the endangered species LOC for freshwater fish:<br>• Maine potatoes (ground and aerial application), Florida tomatoes, peanuts, and turf (at the maximum application rate of 4 times per year).<br>• Use of fluoxastrobin on Idaho potatoes (aerial application only), Maine potatoes (ground and aerial application), tomatoes, peppers, cabbage, peanuts, and turf (at maximum [4x/year] and reduced [2x/year] application rates) indicate endangered LOC exceedances for endangered freshwater invertebrates.<br>• Use of fluoxastrobin on Idaho and Maine potatoes (aerial and ground application), tomatoes, peppers, cabbage, peanuts, and turf (at maximum [4x/year] and reduced [2x/year] application rates) indicate endangered acute and chronic LOC exceedances for estuarine/marine invertebrates.<br>• Use of fluoxastrobin on Maine potatoes (ground and aerial application), Florida tomatoes, peppers, cabbage, peanuts, and turf in Florida (at maximum [4x/year] application rates only) and Pennsylvania (for applications of both 4 and 2x/year) indicate chronic LOC exceedances for estuarine/marine mollusks.<br><br>The list of endangered/threatened freshwater fish species where potatoes, tomatoes, peppers, and peanuts are grown is comprised of 84 different species representing 36 States. The three States with the largest number of endangered/threatened freshwater fish species include California, Washington, and Oregon. Within these States, the majority of endangered/threatened fish species are salmon and steelhead (Orcorhynchus sp.). The predominant endangered fish species in Florida and North Carolina, where tomatoes, peppers, and peanuts are grown, is the sturgeon (Acipenser sp.). The list is of freshwater invertebrates is primarily comprised of bivalves (70% of all listed invertebrates; present in 20 States), crustaceans (i.e., amphipods, crayfish, and shrimp) (~19 of all listed invertebrates; present in 6 States), and snails (~11% of all listed invertebrates; present in 2 States). While the majority of listed freshwater invertebrates are bivalves, the amphipod (Gammarus acherondytes) was listed as endangered in Illinois. The identification of an endangered amphipod is a factor because this species was identified as the most sensitive freshwater invertebrate from the available effects data. It appears, however, that the endangered amphipods in Illinois are present only in caves, where pesticides are not likely to be present in water at concentrations that would cause adverse effects. The Agency's levels of concern for endangered and threatened freshwater fish and invertebrates and estuarine/marine invertebrates and mollusks are exceeded for the use of fluoxastrobin. |
| Flurprimidol | From EPA-HQ-OPP-2009-0630-0005, Problem Formulation for Ecological Risk Assessment for Flurprimidol<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a234a3: |

| | |
|---|---|
| | Based on all available data and the expected exposures due to the new uses assessed, it was determined that flurprimidol would pose minimal acute risks to freshwater fish and invertebrates, birds, and mammals. However, chronic risk quotients for mammals exceeded the Agency's level of concern, suggesting that there is a potential for reproductive effects as a result of the proposed use pattern. |
| Fluvalinate | From 2005 RED for Fluvalinate http://www.epa.gov/oppsrrd1/REDs/taufluvalinate_red.pdf:<br><br>Based on available screening-level information for tau-fluvalinate, there is a potential concern for acute and chronic effects on listed freshwater fish and invertebrates, and for acute effects on listed estuarine/marine fish. There is also potential concern for chronic effects on listed mammals should exposure actually occur. Potential risks to listed insects cannot be precluded given that tau-fluvalinate is highly toxic to honeybees (acute contact LD50 is 0.2 ug/bee). Marine/estuarine invertebrates – exceeds acute LOC (Mysid) for California carrots and nationwide ornamentals. |
| Folpet | From 1999 RED for Folpet http://www.epa.gov/oppsrrd1/REDs/0630red.pdf:<br><br>Air blast applications of folpet, at the maximum label rates for avocado, are expected to exceed high acute risk, restricted use, and endangered species LOCs for freshwater invertebrates. Levels of concern (LOC) are expected to be exceeded for aquatic organisms exposed to single or multiple applications of this fungicide. Chronic risk to the meadow vole is slightly above the level of concern (LOC=1.05) when using maximum residues (Fletcher 1994) on short grass. Air blast applications of folpet, at the maximum label rates for avocado, are expected to exceed high acute risk, restricted use, and endangered species LOCs for fish. |
| Forchlorfenuron | From 2004 Fact Sheet for Forchlorfenuron http://www.epa.gov/opprd001/factsheets/forchlorfenuron.pdf:<br><br>[T]he Agency is concerned about avian chronic toxicity because of observed reproductive effects in a rat study, and the fact that birds are generally more sensitive than mammals. It is highly persistent in the environment with laboratory half- lives ranging from 226-578 days in terrestrial environments and stable in aquatic environments. |
| Formetanate hydrochloride | From 2007 IRED for Formetanate hydrochloride http://www.epa.gov/pesticides/reregistration/REDs/formetanatehcl_ired.pdf:<br><br>The preliminary risk assessment for endangered species indicates that RQs exceed endangered species LOCs for birds and mammals with acute RQs ranging up to 0.2 for birds and up to 18 for mammals. Chronic RQs ranged up to 5 for |

| | |
|---|---|
| | birds and 28 for mammals. |
| Fosthiazate | From EPA-HQ-OPP-2009-0267-0003 (2009 Registration Review Problem Statement for Fosthiazate) http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0513%20#documentDetail?R=09000064809d12db:<br><br>For all use patterns applied by spray methods, the previous assessment found that fosthiazate would pose acute risk to birds, mammals and pollinators such as honey bees as well as chronic risk to birds and mammals. It would pose acute and chronic risk to endangered birds and mammals as well as acute risk to endangered insects. At the highest application rates, fosthiazate exceeded the LOC for acute risk to endangered freshwater aquatic invertebrates. |
| Furanones (heptyl and pentyl) | From 1996 RED for Furanones http://www.epa.gov/oppsrrd1/REDs/3138red.pdf:<br><br>Use of the mosquito larvicide containing furanones (Reg. No. 45987-6) may have harmful effects on endangered species of aquatic invertebrates. |
| Hexazinone | From 1994 RED for Hexazinone http://www.epa.gov/oppsrrd1/REDs/0266.pdf:<br><br>Hexazinone exceeds the endangered species LOCs for both aquatic and terrestrial plants at all use rates. Hexazinone exceeds the endangered species level of concern, using typical residues, for grass and insect eating mammals at use rates of 3.6 lbs ai/acre or greater. Using the maximum application rate for the granular formulation, which is 12 lbs ai/acre, and assuming no soil incorporation results in a risk quotient of 0.3 which exceeds the acute avian LOC for endangered birds. |
| Hydramethylnon | From 1998 RED for Hydramethylnon http://www.epa.gov/oppsrrd1/REDs/2585red.pdf:<br><br>For mammals, no acute risks are evident. However, there is a potential for chronic risks to terrestrial mammals consuming hydramethylnon baits. Concentrations of hydramethylnon in bait formulations exceed the mammalian reproduction NOEC and encompass the LOEC. It is therefore possible that dietary incorporation of baits in the field may result in oral exposures approximating reproductive toxicity thresholds in mammalian wildlife. In addition, the Agency does have adverse incident data from the use of hydramethylnon, although the certainty of the incidents is unknown at present.<br><br>No toxicological data are available to quantitatively assess chronic risks to avian species. However, observation of reproductive effects in mammals suggest that oral exposure of other organisms to hydramethylnon may result in chronic reproductive effects. In the absence of toxicological data to the contrary, the |

| | |
|---|---|
| | Agency assumes that hydramethylnon has a potential to cause chronic reproductive effects in avian species at concentrations representative of hydramethylnon use in bait formulations. On the basis of this assumption, it is therefore possible that outdoor uses of hydramethylnon baits may pose a risk to avian wildlife. |
| Imazapyr and salts | From EPA-HQ-OPP-2005-0495-0009, Level I Screening Ecological Risk Assessment for the Reregistration of Imazapyr http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2005-0495%20#documentDetail?R=09000064800fc1c8:<br><br>The preliminary risk assessment for endangered species indicates that imazapyr exceeds the Endangered Species LOCs for the specified use scenario in the following taxonomic groups:<br>• freshwater/estuarine/marine vascular plants for non-crop uses (both high and low application rates) and for direct application to water<br>• non-target terrestrial plants - monocots and dicots adjacent to treated areas, semi-aquatic areas, and drift for non-crop uses at both high and low application rates by ground and aerial spray and granular applications, and drift from Clearfield corn use by ground and aerial spray application; monocots adjacent to semi-aquatic areas for Clearfield corn use by ground spray application; and monocots adjacent to treated areas and semi-aquatic areas for Clearfield corn use by aerial spray application.<br>• non-target terrestrial plants - monocots and dicots adjacent to treated water bodies and drift for non-crop aquatic use at an application rate of 1.5 lb ae/acre by ground and aerial spray application. |
| Indoxacarb | From 2000 Fact Sheet for Indoxacarb http://www.epa.gov/opprd001/factsheets/indoxacarb.pdf:<br><br>The level of concerns for endangered species (0.05) were only marginally exceeded for one scenario (estuarine/marine invertebrates) for indoxacarb, its R-enantiomer and one degradate (JT333). The level of concerns for endangered species were exceeded for two avian scenarios and one avian food item as a result of multiple applications of indoxacarb and its R-enantiomer. Several subchronic/chronic levels of concern for small mammals (1.0) were exceeded for several food items. Risks to bees via the dietary route were considered minimal; however, high toxicities were noted by the contact routes. |
| Iprodione | From EPA-HQ-OPP-2009-0081-0072, 2007 Registration Review Problem Formulation for Iprodione http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0513%20#documentDetail?R=09000064809240ba:<br><br>At the proposed and revised application rates, the acute risk to endangered birds LOC is exceeded for uses with multiple applications of 0.5 lbs a.i../A (almonds, |

| | |
|---|---|
| | pistachio, stone fruits and grapes). Except for use on canola, the chronic risk LOC is exceeded for birds as well. Again, except for canola, the acute risk to listed species LOC and the chronic risk LOC are exceeded for various-sized mammals feeding in several forage categories. Because of updating in exposure assessment methods since the previous iprodione assessment, several additional registered uses were also evaluated and demonstrate that following applications to rice, the acute risk endangered species LOC is exceeded for fish by a factor 3.2X, and the acute risk to aquatic invertebrate LOC is exceeded by factors ranging between 2.6 to 42X for row crops, turf and rice. |
| Isoxaflutole | From EPA-HQ-OPP-2009-0081-0047, 1997 Summary of Ecorisks for Isoxaflutole<br>http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0513%20#documentDetail?R=09000064809240a0:<br><br>There is phytotoxicity risk to non-target aquatic and terrestrial plants from runoff of parent isoxaflutole and it's transformation products. Endangered plant species may be affected from the proposed use of isoxaflutole. Chronic risk to birds, mammals, shrimp and estuarine fish cannot be determined because data on the transformation products have not been submitted.<br><br>From 1998 Fact Sheet for Isoxaflutole:<br>http://www.epa.gov/opprd001/factsheets/isoxaflutole.pdf<br><br>Isoxaflutole  is highly toxic to the mysid shrimp (96-hour LC50/EC50 = 0.018 ppm) and moderately toxic to the eastern oyster (96-hour LC50/EC50 = 3.3 ppm). Isoxaflutole is highly toxic terrestrial plants (EC25 = 1 X 10-5 pounds active ingredient/Acre). |
| Linuron | From 1995 RED for Linuron<br>http://www.epa.gov/oppsrrd1/REDs/0047.pdf:<br><br>Levels of concern from linuron use have been exceeded for acute effects to birds, mammals, fish, aquatic invertebrates, aquatic plants and endangered species. High risk to terrestrial plants is likely, based on the herbicidal properties of linuron. In addition, levels of concern for chronic effects have been exceeded for birds and mammals. Chronic effects to fish cannot be fully evaluated since a NOEL was not determined. Chronic effects to aquatic invertebrates cannot be evaluated due to inconsistencies between acute and chronic testing. |
| Malathion | From 2009 Revised RED for Malathion<br>http://www.epa.gov/pesticides/reregistration/REDs/malathion-red-revised.pdf:<br><br>Based upon the screening-level assessment conducted on malathion, the Agency has identified several exceedences of the acute and chronic endangered LOC in certain cases for birds, mammals, fish and invertebrates should exposures actually |

| | |
|---|---|
| | occur at modeled levels. Data indicate that malathion may be highly toxic to bees, and has been shown to be lethal to many species of beneficial insects when used near or over non- agricultural areas containing beneficial insect populations. |
| Maleic hydrazide and salts | From 1994 RED for Maleic hydrazide http://www.epa.gov/oppsrrd1/REDs/0381.pdf:<br><br>The Agency has concerns about the exposure of threatened and endangered plant species to maleic hydrazide. Based on the conclusions discussed in the preceding sections of this risk assessment, applications of maleic hydrazide, even at low application rates, pose a significant risk to endangered plant species inhabiting treated rights-of-way. A risk from runoff of maleic hydrazide also occurs to endangered plant species growing in wetter areas away from treated sites. |
| Mancozeb | From 2005 RED for Mancozeb http://www.epa.gov/oppsrrd1/REDs/mancozeb_red.pdf:<br><br>Available screening-level information for mancozeb indicate a potential concern for chronic effects on listed species of birds and mammals, acute and chronic effects on listed species of freshwater fish and freshwater invertebrates, and acute effects on listed species of estuarine/marine fish should exposure actually occur. |
| Maneb | From 2005 RED for Maneb:<br><br>Based on available screening level information, there is a potential concern for maneb's acute effects on listed freshwater and estuarine/marine animals and chronic effects on listed birds and mammals should exposure actually occur. |
| MCPA, salts and esters | From 2004 RED for MCPA http://www.epa.gov/oppsrrd1/REDs/mcpa_red.pdf:<br><br>Based on EPA's screening level assessment, RQs exceed levels of concern for MCPA use sites for endangered species of mammals, birds, aquatic plants, and terrestrial plants. |
| MCPB and salts | From 2006 RED for MCPB http://www.epa.gov/oppsrrd1/REDs/mcpb_red.pdf:<br><br>The Agency's level of concern for direct acute effects to endangered and threatened birds, and terrestrial and semi-aquatic plants, and for direct acute and chronic effects to mammals, is exceeded for the use of MCPB. |

| | |
|---|---|
| MCPP, MCPP-P and salts | From 2007 RED for MCPP http://www.epa.gov/oppsrrd1/REDs/mcpp_red.pdf:<br><br>Based on EPA's screening level assessment for MCPP-p, RQs exceed the LOCs for mammals, birds, and terrestrial plants. The acute endangered RQs exceeded the LOC (0.1) for birds. Based on estimated chronic RQs, the LOC for non-endangered birds is exceeded for most food items. Dose-based acute RQs for mammals exceed the acute LOC based on MCPP-p spray applications, but acute RQs exceed the LOC of 0.1 for endangered mammals in both MCPP-p spray and granular applications. Based on the MCPP-p spray application, mammalian chronic dose-based RQs exceeds the LOC. Using EECs based on the maximum single application rate of 1.2 lbs ae MCPP-p/A, all RQs exceed the Agency's LOC of 1 for non-endangered and endangered plant species. |
| Mefluidide and salts | From EPA-HQ-OPP-2007-0431-0023, Ecological Risk Assessment for Mefludide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480360a2c:<br><br>An analysis indicates exceedance of the Acute Risk LOC for listed and non-endangered monocots and dicots in dryland and semi-aquatic areas located adjacent to treated areas, both as a result of combined runoff and spray drift, and from spray drift alone for mefluidide-DEA and mefluidide-K. Screening-level acute listed LOCs are exceeded for terrestrial organisms potentially exposed to residues by Mefluidide applications. The acute risk quotients for mammals are as high as 0.26, above the acute listed LOC of 0.05. Acute listed LOCs were exceeded for 20 g and 100 g birds and acute restricted use LOCs were exceeded for 20 g birds that were exposed to and consumed various feed items. There are potential concerns for indirect effects on aquatic organisms (fish, invertebrates, and plants) due to the potential for changes in the habitat adjacent to water bodies. |
| Mesosulfuron-methyl | From 2004 Fact Sheet for Mesosulfuron-methyl http://www.epa.gov/opprd001/factsheets/mesosulfuron-methyl.pdf:<br><br>Mesosulfuron is phytotoxic to endangered and non-endangered non-target terrestrial plants and and plants growing in semi-aquatic habitats. It is also phytotoxic to aquatic vascular plants. |
| Metaldehyde | From 2006 RED for Metaldehyde http://www.epa.gov/oppsrrd1/REDs/metaldehyde_red.pdf:<br><br>Acute RQs exceed the LOC for listed species for small- and medium-sized birds in artichokes, berries, cole crops, citrus, grass grown for seed, strawberries, and dichondra/turf. Acute RQs exceed the LOC for listed species of all sizes of birds in ornamentals. Acute RQs exceed the LOC for listed species for small- and |

| | |
|---|---|
| | medium-sized mammals in artichokes, berries, cole crops, citrus, grass grown for seed, strawberries, and dichondra/turf. |
| Methidathion | From 2006 IRED for Methidathion http://www.epa.gov/pesticides/reregistration/REDs/methidathion_ired.pdf:<br><br>All uses of methidathion exceed the endangered species LOC for all forms of endangered animal species: avian acute and chronic, mammalian acute and chronic, freshwater fish acute and chronic, freshwater invertebrate acute and chronic, marine/estuarine fish acute and chronic. Methidathion is classified as very highly toxic to bees on an acute contact basis. |
| Methiocarb | From 1994 RED for Methiocarb http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648092409b:<br><br>The acute and chronic levels of concern are exceeded for avian species, the acute level of concern is exceeded for mammalian species and aquatic invertebrates, and the chronic level of concern is exceeded for aquatic organisms for all formulations of methiocarb. |
| Methomyl | From 1998 RED for Methomyl http://www.epa.gov/oppsrrd1/REDs/0028red.pdf:<br><br>Terrestrial species:<br>Avian chronic LOCs (based on avian reproductive toxicity data) are exceeded for both average and maximum EECs from multiple applications even at the lowest application rate of 0.225 lbs a.i./A. RQs suggest that seed eating birds are at less risk than insectivores or birds that feed on short grass or other herbaceous material. Mammalian acute dietary RQs are considerably greater than avian RQs and exceed the LOCs for endangered species, acute restricted use and acute high risk for herbivores and insectivores for all application rates. This is especially the case for multiple applications. However, for granivores (seed eaters) only acute RQs at the highest single application rate exceed the endangered species LOCs. Multiple applications only exceed the acute endangered species and acute restricted use LOCs at application rates equal to or greater than 0.45 pounds a.i./A. Unlike avian species, many small rodents and other mammals consume copious amounts of grass and herbaceous material. As such, the likelihood that mammals, especially herbivores and insectivores, will be adversely affected is considerably greater than for birds.<br><br>Mammalian chronic RQs based on reproductive toxicity data suggest that even from a single application, the chronic LOC is exceeded at registered maximum application rates equal to or greater than 0.45 lbs. a.i./A for herbivores (based on residues for short grass). However, chronic LOCs for insectivores are only exceeded at application rates greater than or equal to 0.90 lbs. a.i./A. Chronic |

| | |
|---|---|
| | LOCs are not exceeded for seed-eaters at any application rate for either single or multiple applications.<br><br>Aquatic species:<br>RQs generated by PRZM/EXAMS indicate that acute endangered species LOCs are exceeded for freshwater fish at application rates equal to or greater than 0.225 lbs a.i./A and for estuarine fish at application rates equal to or greater than 0.45 lbs. a.i./A. Acute restricted use LOCs for freshwater fish are only exceeded at maximum application rates equal to or greater than 0.45 lbs a.i./A. Chronic risk LOCs for freshwater fish (based on a fathead minnow early life stage study) are exceeded at multiple application rates greater than 0.45 lbs. a.i./A. Finally, the direct application of methomyl to a 6 inch layer of water (as is likely to occur from spraying citrus groves) at an application rate equal to or greater than 0.9 lbs. a.i./acre will result in chronic hazard to freshwater fish as well as exceeding the LOCs for acute endangered species and acute restricted use. RQs generated by PRZM/EXAMS indicate that acute endangered species, acute restricted use and acute high risk LOCs are exceeded for freshwater and estuarine invertebrates at application rates equal to or greater than 0.225 lbs. a.i./A. Chronic risk LOCs (based on a daphnia life-cycle study) for freshwater invertebrates are exceeded at multiple application rates greater than 0.225 lbs. a.i./A. These chronic RQs range from 46.6 (multiple applications of 0.225 lbs.a.i./A for lettuce) to 158.3 (multiple applications of 1.8 lbs. a.i./A for peaches). Finally, the direct application of methomyl to a 6 inch layer of water (as is likely to occur from spraying citrus groves) at an application rate equal to or greater than 0.9 lbs. a.i./acre exceeds the acute endangered species, acute restricted use and acute high risk LOCs as well as the chronic LOC for freshwater invertebrates. |
| Methoxyfenozide | From EPA-HQ-OPP-2007-0495-0009 for Methoxyfenozide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064803b87b7:<br><br>Based on the proposed maximum application rates, there is a potential for adverse effects to freshwater invertebrates from acute and chronic exposure to methoxyfenozide for all of the proposed new uses. There is also a potential risk to estuarine/marine invertebrates from most of the proposed uses (chronic exposure), and the dry beans and green onion proposed uses (acute exposure). Additionally, the chronic risk level of concern (LOC) for mammals is exceeded fro most of the mammalian size-classes and dietary categories modeled for all of the proposed new uses using a conservative systemic endpoint. Indirect effects are indicated for all listed taxon. |
| Methyl Bromide | From EPA-HQ-OPP-2009-0081-0026 for Methyl bromide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648092408b:<br><br>It is expected that any insects or other terrestrial invertebrates exposed to methyl |

| | |
|---|---|
| | bromide would be adversely affected. Although endangered species LOCs are exceeded using freshwater invertebrate data,<br>the oyster (marine/estuarine) is very likely to be more representative of endangered/threatened freshwater molluscs than is the freshwater daphnid. |
| Methyl parathion | From 2006 RED for Methyl parathion http://www.epa.gov/pesticides/reregistration/REDs/methyl_parathion_red.pdf:<br><br>Endangered species LOCs are exceeded for acute and chronic risks to birds, mammals and freshwater and estuarine/marine invertebrates, fish, amphibians, reptiles and terrestrial invertebrates (including insects). Acute toxicity testing shows that methyl parathion is highly toxic to honeybees. |
| Metiram | From 2005 Revised RED for Metiram http://www.epa.gov/oppsrrd1/REDs/metiram_red_revised.pdf:<br><br>Based on available screening-level information, there is a potential concern for acute effects on listed birds and freshwater fish species, and chronic effects on listed birds and mammals should exposure actually occur. Even though metiram is only slightly acutely toxic to birds, RQs exceed the endangered species LOC (RQ range from 0.11 to 1.02) at maximum EEC levels. Avian and mammalian RQs exceed the chronic LOCs for almost all use metiram modeled exposures. Highly toxic to freshwater invertebrate. |
| Metofluthrin | From 2006 Fact Sheet for Metofluthrin http://www.epa.gov/opprd001/factsheets/metofluthrin.pdf:<br><br>Metofluthrin, like other synthetic pyrethroids, is practically non-toxic to mammals and birds, but it is highly to very highly toxic to aquatic animals and insects. Its repellency power is related to its insecticidal character. The published literature supports its character both as a repellent and as an insecticide. No Level of Concern was exceeded, but the insecticidal properties of metofluthrin imply that it will pose a risk to non-target insects and to species federally listed as endangered or threatened by the United States government. |
| Metolachlor and S-Metolachlor | From 1995 RED for Metolachlor http://www.epa.gov/oppsrrd1/REDs/0001.pdf:<br><br>The level of concern for acute effects to avian species eating short grass is exceeded at an application rate of 6 lbs./acre for non-granular formulations using maximum EEC's (risk quotient=0.1). The level of concern is exceeded, using the maximum EEC, for small mammals eating short grass at an application rate of 2 lbs./acre (risk quotient=0.1). The roadside use (application rate of 1.25 lbs. ai/acre) exceeds the level of concern for acute effects to endangered fish (risk quotient=0.12). |

| | |
|---|---|
| Metribuzin | From 1998 RED for Metribuzin:<br>http://www.epa.gov/oppsrrd1/REDs/0181red.pdf<br><br>Endangered species LOCs for birds, mammals, terrestrial plants, and aquatic plants are exceeded for metribuzin. |
| N-Octyl bicycloheptene dicarboximide | From 2006 RED for N-Octyl bicycloheptene dicarboximide<br>http://www.epa.gov/oppsrrd1/REDs/mgk_red.pdf:<br><br>The preliminary risk assessment for endangered species indicates that RQs exceed endangered species LOCs for aquatic organisms. |
| Naled | From 2006 RED for Naled<br>http://www.epa.gov/pesticides/reregistration/REDs/naled_red.pdf:<br><br>Endangered species LOCs for naled are exceeded for birds, mammals, freshwater fish, and freshwater and estuarine invertebrates. Naled was included in the formal Section 7 consultation with the US Fish and Wildlife Service (USFWS) for the rangeland cluster review in 1984. The Biological Opinion stated that this use of naled would jeopardize the continued existence of 40 species of freshwater fish, 22 species of freshwater mussels, four species of amphibians, one aquatic crustacean and three terrestrial insect species. |
| Napropamide | From 2005 RED for Napropamide<br>http://www.epa.gov/oppsrrd1/REDs/napropamide_red.pdf:<br><br>Based on EPA's screening level assessment, RQs for napropamide exceed acute levels of concern for direct effects to endangered species of mammals, mollusks, marine/estuarine crustaceans, aquatic vascular plants and terrestrial and semi-aquatic plants (both dicots and monocots). |
| Nicobifen | From 2003 Fact Sheet for Nicobifen<br>http://www.epa.gov/opprd001/factsheets/boscalid.pdf:<br><br>The acute risk level of concern for endangered species is exceeded for estuarine/marine invertebrates. Chronic exposure to boscalid at the proposed application rate for strawberries, i.e., 5 applications of 0.350 lbs a.i./A with a 7-day reapplication interval, results in the chronic risk level of concern being exceeded for birds feeding on short grasses (RQ=1.08). |
| Oryzalin | From 1994 RED for Oryzalin<br>http://www.epa.gov/oppsrrd1/REDs/0186.pdf:<br><br>In shallow water (6 in) adjacent to treated fields, the EECs exceed 0.05 LC50 values for all aquatic species tested (Daphnia magna, 0.075 ppm; rainbow trout, 0.165 ppm; bluegill sunfish, 0.145 ppm) and the MATC value for the fathead |

| | |
|---|---|
| | minnow, 0.2 ppm. As would be expected of a herbicide, oryzalin poses an acute risk to non-target plants, including threatened and endangered plants. |
| Oxadiazon | From 2003 RED for Oxadiazon http://www.epa.gov/oppsrrd1/REDs/oxadiazon_red.pdf:<br><br>Endangered species LOCs for liquid and granular formulations of oxadiazon are exceeded for acute risks to birds, mammals, freshwater and estuarine fish and invertebrates and aquatic vascular plants. |
| Oxamyl | From 2007 RED for Oxamyl http://www.epa.gov/pesticides/reregistration/REDs/oxamyl_red.pdf:<br><br>Acute and chronic risks are possible for avian and mammalian endangered species from oxamyl use. The high acute and chronic toxicity of the compound, as well as, high single application rates, multiple applications and unincorporated applications contribute to the risk. Risks to some aquatic organisms (freshwater and estuarine/marine invertebrates) were evident as well. Results from field studies suggest that endangered/threatened amphibians may also be at risk. |
| Oxydemeton-Methyl | From 2006 RED for Oxydemeton-Methyl http://www.epa.gov/pesticides/reregistration/REDs/odm_red.pdf:<br><br>Endangered species LOCs for ODM are exceeded for acute risks to birds and mammals for all application rates and feed items except for expected residues on seeds from rates less than 0.75 lbs ai/A. Since ODM is an insecticide, it is assumed that endangered terrestrial invertebrates, including insects, are potentially at risk.<br><br>ODM was included in the reinitiated Biological Opinion of 1989 from the US Fish and Wildlife Service for its use on several field crops and in forestry for use on douglas fir. In this opinion, the Service found jeopardy to one amphibian species, the Wyoming toad, and four species of freshwater fish. |
| Oxyfluorfen | From 2002 RED for Oxyfluorfen http://www.epa.gov/oppsrrd1/REDs/oxyfluorfen_red.pdf:<br><br>The preliminary risk assessment for endangered species indicates that oxyfluorfen exceeds the endangered species LOCs for the following combinations of analyzed uses and species: terrestrial plants for all uses; avian chronic for non-bearing citrus and all applications with rates greater than 0.5 lb ai/acre/application (such as rights-of-way, apples, walnuts and grapes) based on both maximum and mean residue levels; mammalian chronic for non-bearing citrus, and applications with rates of 2 lbs ai/acre (such as rights-of-way, apples, walnuts and grapes) based on maximum residues; freshwater fish for non-bearing citrus and grapes (of those scenarios modeled); and estuarine fish for non-bearing |

| | |
|---|---|
| | citrus, apples and grapes (of those scenarios modeled); and freshwater invertebrates for non-bearing citrus, apples, grapes and cotton (of those scenarios modeled).<br><br>The Agency had a consultation in 1985 (amended in 1986) with the US Fish and Wildlife Service (FWS or the Service) on oxyfluorfen (Goal 1.6E and Goal 2E) regarding its use on non-crop areas including rights-of ways, fence rows, roadsides, and levee banks. The Service found jeopardy to 76 species of endangered plants, 54 species of endangered fish, 23 species of endangered mussels (clams), two species of snails, eleven species of endangered insects, four endangered amphibians and one endangered bird (piping plover). Oxyfluorfen was included in the corn cluster consultation in 1983, and it's uses on crops and forests were also included in the "reinitiation" of clusters in 1988. The resulting 1989 opinion found jeopardy to one amphibian (the Wyoming toad which is extirpated in the wild except on FWS refuges), five fish species, two species of crustaceans and one bird species (the wood stork). |
| Paraquat dichloride | From 1997 RED for Paraquat dichloride<br>http://www.epa.gov/oppsrrd1/REDs/0262red.pdf:<br><br>Levels of Concern have been exceeded for endangered species of birds at application rates greater than or equal to 0.30 lb cation/A. Levels of Concern have also been exceeded for endangered mammalian species for all labeled application rates > 0.55 lb cation/A. |
| PCNB | From 2006 RED for PCNB<br>http://www.epa.gov/oppsrrd1/REDs/pcnb_red.pdf:<br><br>Endangered species LOCs associated with the use of PCNB are exceeded for aquatic and terrestrial species. Risk Quotients for PCNB, reflecting mitigation measures proposed by the registrants, indicate a potential for acute and chronic risks to listed species associated with the modeled use sites, as noted below:<br>Chronic RQs exceed LOCs for cole crops, peanuts, cotton, and potatoes for all mammals feeding on short grass, tall grass, and broadleaf plants and insects<br>Chronic RQs exceed LOCs for turf for all mammals feeding on all forage items<br>Chronic RQs exceed LOCs for cole crops and potatoes for birds feeding on short grass, tall grass, and broadleaf plants and insects<br>Chronic RQs exceed LOCs for turf for birds feeding on all forage items<br>Chronic RQs exceed LOCs for seed-eating birds for all modeled seed treatments<br>Chronic RQs exceed LOCs for treated seeds of barley, cotton, oats, peas, rice, soybean, and sugar beet for seed-eating birds<br>Chronic RQs exceed LOCs for treated seeds of all types for seed-eating mammals<br>Freshwater fish (aquatic-phase amphibians): Acute RQs exceed LOCs for all sites<br>Freshwater invertebrates: Acute RQs exceed LOCs for cole crops<br>Estuarine/marine invertebrates: Acute RQs exceed LOCs for all sites |

| | |
|---|---|
| Pendimethalin | From 1997 RED for Pendimethalin http://www.epa.gov/oppsrrd1/REDs/0187red.pdf:<br><br>The use of pendimethalin may adversely effect endangered species of terrestrial and semi-aquatic plants, aquatic plants and invertebrates including mollusks, fish, and birds (specifically grazers). |
| Pentachlorophenol and salts | From 2008 RED for Pentachlorophenol http://www.epa.gov/oppsrrd1/REDs/pentachlorophenol_red.pdf:<br><br>There are potential acute and chronic risks to birds and chronic risks to mammals from CDDs and CDFs resulting from pentachlorophenol treated wood. |
| Permethrin | From 2007 RED for Permethrin http://www.epa.gov/oppsrrd1/REDs/permethrin_red.pdf:<br><br>Freshwater Fish and Aquatic-phase Amphibians - The acute endangered LOC (RQ >0.05) for direct effects were exceeded for all maximum application rates for corn, sweet corn, potatoes, alfalfa, orchards, tomatoes, and mosquito abatement modeled scenarios. Freshwater Invertebrates- The acute and chronic LOC was exceeded for the maximum application rate for all crops relative to aquatic macroinvertebrate exposure. Estuarine/Marine Fish- The acute endangered LOC (acute RQ >0.05) is exceed for all maximum application rates. Estuarine/Marine Invertebrates- The endangered species acute LOC and chronic LOC is exceeded for all modeled use sites and maximum label rates. |
| Phenothrin | From 2008 RED http://www.epa.gov/oppsrrd1/REDs/sumithrin_(d-phenothrin)_red.pdf:<br><br>Phenothrin is very highly toxic to freshwater invertebrates. The EC50 for freshwater invertebrates is 4.4 µg/L. Based on this toxicity value, the RQs for acute risks to freshwater invertebrates were ≤ 0.07. These RQs are below the Agency's LOC for non-listed species, but are above the Agency's LOC of 0.05 for aquatic endangered species. |
| Phorate | From 2006 RED for Phorate http://www.epa.gov/pesticides/reregistration/REDs/phorate_red.pdf:<br><br>Phorate is highly toxic to birds and small mammals when applied at label rates. The R Q values for terrestrial animals exceed the acute risk level of concern for all species, crops, and application rates. The Agency has also identified a concern for aquatic endangered species, on an acute and chronic basis from the use of phorate. |

| | |
|---|---|
| Phosmet | From 2006 RED for Phosmet<br>http://www.epa.gov/pesticides/reregistration/REDs/phosmet_red.pdf:<br><br>Studies suggest that on certain crops, where there is a high application rate and frequent application of phosmet, expected environmental concentrations can lead to acute risk for mammals; chronic risk for birds and mammals; and acute and chronic risks to invertebrates. In addition, phosmet is highly toxic to honey bees. |
| Picloram and salts | From 1995 RED for Picloram<br>http://www.epa.gov/oppsrrd1/REDs/0096.pdf:<br><br>Picloram may pose a significant risk to on- and off-site endangered terrestrial, semi- aquatic, and aquatic plant species and may also have adverse effects on other on and off-site nontarget plants. Risks to nontarget terrestrial plants are very significant (endangered species and otherwise) for all active ingredients and all application methods considered. For aquatic animals, estimated exposures exceed levels of concern in two cases: Levels of concern are exceeded for endangered fish species for the potassium salt administered by ground application without incorporation, and for endangered mollusks based on the TIPA salt applied aerially. For mammals, exposure to endangered terrestrial species will likely exceed levels of concern for TIPA and potassium salts, administered by all application methods considered. |
| Piperonyl butoxide | From 2006 RED for Piperonyl butoxide<br>http://www.epa.gov/oppsrrd1/REDs/piperonyl_red.pdf:<br><br>The preliminary risk assessment for endangered species indicates that RQs exceed endangered species LOCs for freshwater fish, freshwater invertebrates, freshwater amphibians, and estuarine/marine invertebrates. Further, potential indirect effects to any species dependent upon a species that experiences effects from use of PBO can not be precluded based on the screening level ecological risk assessment. |
| Pirimicarb | From 1997 Fact Sheet for Pirimicarb<br>http://www.epa.gov/opprd001/factsheets/pirimicarb.pdf:<br><br>Aquatic EEC's exceed the acute and chronic LOC's for endangered aquatic invertebrates. The only endangered species which generate any concern are six species of endangered mollusks found in Idaho. |
| Potassium and Sodium Nitrate (used as burrow fumigants) | From 1991 RED Potassium and Sodium Nitrate<br>http://www.epa.gov/oppsrrd1/REDs/old_reds/4052red.pdf:<br><br>The Agency realizes that any organism in a properly treated burrow will likely be killed and is concerned about potential impact to populations of non-target and endangered species. The open literature indicates that several types of non-target |

| | |
|---|---|
| | organisms, including burrowing owls, may inhabit the burrows of target pests. The use of these products may also result in a potential impact on endangered species which utilize burrows. Gas cartridges have been the subject of several formal and informal consultations with the U.S. Fish and Wildlife Service, and as a result, six endangered or threatened species that utilize burrows have been identified as being at risk. |
| Profenofos | From 2006 RED for Profenofos http://www.epa.gov/pesticides/reregistration/REDs/profenofos_red.pdf:<br><br>Profenofos is highly toxic to bees, birds, and small mammals based on test results. |
| Prometryn | From 1996 RED for Prometryn http://www.epa.gov/oppsrrd1/REDs/0467.pdf:<br><br>Prometryn poses an acute risk to nonendangered and endangered terrestrial and aquatic plants, a chronic risk to birds, and an acute risk to endangered small mammals. The endangered species LOC for freshwater fish has been exceeded. The endangered species LOC for all invertebrates has been exceeded for all rates and methods and for fish for ground application. This indicates that the use of prometryn may cause adverse effects to endangered marine/estuarine fish and invertebrates. Prometryn use may also cause adverse effects to freshwater and marine mollusc species. |
| Propachlor | From 1998 RED, EFED Risk Assessment for Propachlor, at EPA-HQ-OPP-2009-0081-0102 http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064809240d1:<br><br>The use of propachlor on corn and sorghum exceeds the endangered species level of concern for birds, mammals, freshwater fish and invertebrates, and plants. |
| Propamocarb hydrochloride | From 1995 RED for Propamocarb hydrochloride http://www.epa.gov/oppsrrd1/REDs/3124red.pdf:<br><br>Endangered species LOCs have been exceeded for birds and mammals for the use of propamocarb hydrochloride on turf and field ornamentals. In addition, the LOCs for endangered marine animals (mollusks) have been exceeded for field-grown ornamentals. Application to woody ornamentals may also exceed endangered species LOCs depending on the application rate used. |
| Propanil | From 2003 RED for Propanil http://www.epa.gov/oppsrrd1/REDs/propanil_red_combined.pdf:<br><br>Using the data available, propanil exceeds a level of concern for: (1) birds (acute |

| | |
|---|---|
| | risk for rice and turf); (2) small mammals (acute and chronic risks for rice and turf); (3) freshwater fish (acute risk for turf); (4) freshwater invertebrates (acute and chronic risks for turf); (5) estuarine/marine fish and invertebrates (acute risk for turf); (6) nontarget terrestrial plants (acute risk for rice and turf); and (7) vascular aquatic plants (acute risk for turf). |
| Propargite | From 2008 RED for Propargite http://www.epa.gov/oppsrrd1/REDs/propargite_amend_red-10-09-08.pdf:<br><br>At currently proposed rates, endangered species risk presumption levels are exceeded for both freshwater and estuarine/marine fish and invertebrates at the label permitted application scenarios for propargite. Mammalian and avian acute risk for endangered species is exceeded for certain species which may feed heavily on vegetation or insects.<br><br>The Agency consulted with the US Fish and Wildlife Service (FWS or the Service) on the corn use of propargite as part of the corn cluster analysis in 1983 and on several agricultural uses of propargite in the "reinitiation" of the cluster assessments in 1988. The resulting Opinions found jeopardy to one amphibian species, eight fish species and one invertebrate species. |
| Propiconazole | From 2006 RED for Propiconazole http://www.epa.gov/oppsrrd1/REDs/propiconazole_red.pdf:<br><br>Acute RQs for turf and ornamentals exceed LOCs for small mammals feeding on short grass, tall grass, broadleaf forage and small insects; Chronic RQs for turf and ornamentals exceed LOC for all mammals feeding on short grass, tall grass, broadleaf forage and small insects; Acute RQs for turf and ornamentals exceed LOCs for all birds feeding on short grass and tall grass and for smaller birds feeding on broadleaf forage and small insects; Chronic RQs for turf and ornamentals barely exceed the LOC. Acute RQs for turf and ornamentals exceed LOCs for listed terrestrial plants (monocots and dicots) adjacent to treated sites and in semiaquatic areas; Acute fish RQ for rice exceeds LOC for listed species; Acute invertebrate RQs for turf and rice exceed LOC for listed species; Because no data are available to evaluate chronic risks to estuarine/marine fish, EPA has a potential concern for listed species. |
| Propoxur | From 1997 RED for Propoxur http://www.epa.gov/oppsrrd1/REDs/2555red.pdf:<br><br>The results indicate that for applications of bait products, avian acute high risk, restricted use, and endangered species levels of concern are exceeded at the registered application rate of 4 oz ai per 1000 sq ft. The results indicate that for small mammals (15 gramweight), acute high risk, restricted use, and endangered specieslevels of concern are exceeded at the registered application rate of4 oz per 1000 sq. ft., by 3, 8, and 16 times respectively. |

| | |
|---|---|
| Propylene oxide | From 2006 RED for Propylene oxide http://www.epa.gov/oppsrrd1/REDs/propylene_oxide_red.pdf:<br><br>The Agency's level of concern for direct adverse effects was exceeded for listed species in the following taxonomic groups: monocot terrestrial and semi-aquatic plants, dicot terrestrial and semi-aquatic plants, aquatic vascular plants, and mollusks. There is also the potential for indirect adverse effects for listed species in multiple taxonomic groups that are dependent upon species that do experience direct adverse<br>effects. |
| Propyzamide | From EPA-HQ-OPP-2009-0326-0005, Registration Review Problem Formulation for Propyzamide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a24460:<br><br>Propyzamide, when used in accordance with current labels, can result in off-site movement of the compound via runoff, erosion of sediment-bound residues and spray drift leading to exposure of nontarget plants and animals. Applications to foliar surfaces may serve as a major source of propyzamide exposure to wildlife. This potential exposure pathway may result in adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms. These nontarget organisms include Federally-listed threatened and endangered species.<br><br>An ecological risk assessment of proposed uses on chicory, Belgian endive, dandelion, and berries was completed in 2007 (DP Barcode 329358; Jun. 14, 2007). This assessment identified potential chronic risk to mammals and potential risk to terrestrial and semi-aquatic plants. Potential risk of direct effects was identified to listed mammals, birds, estuarine invertebrates, and terrestrial and semi-aquatic plants. Potential risk of indirect effects was identified for most taxa due to potential risk to plants. An addendum to the ecological risk assessment (DP Barcode 329358; Oct. 22, 2007) indicated no potential risk to listed estuarine invertebrates.<br><br>An endangered species assessment was conducted of risks of propyzamide use to the federally threatened California red-legged frog (CRLF; Rana aurora draytonii) (USEPA 2008). The Agency made a Likely to Adversely Affect determination for the CRLF from the use of propyzamide and determined that there is the potential for modification of CRLF designated critical habitat as well. The use of propyzamide was found likely to adversely affect terrestrial-phase CRLF through chronic effects. Additionally, propyzamide was found likely to adversely affect the terrestrial-phase CRLF through reductions in terrestrial plants that serve as cover. The decrease in terrestrial plants along riparian zones was also found likely to adversely affect the aquatic-phase CRLF through indirect effects on water quality. The use of propyzamide was also found likely to modify the |

| | |
|---|---|
| | principle constituent elements (PCEs) of designated critical habitat for both aquatic- and terrestrial-phase CRLF. |
| Prothioconazole | From 2007 Fact Sheet for Prothioconazole http://www.epa.gov/opprd001/factsheets/prothioconazole.pdf:<br><br>For listed species, acute risk levels of concern were exceeded for estuarine/marine invertebrates, semi-aquatic plants, aquatic plants, and freshwater fish. Listed species chronic risk levels of concern were exceeded for mammals. |
| Pyrasulfotole | From EPA-HQ-OPP-2006-1026-0009, 2007 EFED Risk Assessment for Pyrasulfotole http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a20507:<br><br>Proposed uses of pyrasulfotole have the potential for direct adverse effects for terrestrial and semi-aquatic dicotyledonous plants, some small mammals less than 35 g (chronic exposure), and listed freshwater vascular plants. At this time, no Federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed uses of pyrasulfotole, since there is a potential for indirect effects to taxa that might rely on plants (even at a maximum application rate of 0.023 lb a.i./acre) and/or mammals for some stage of their life-cycle. Based on LOCATES, there is the potential for a total of 390 listed species to be directly affected by the proposed uses of pyrasulfotole, while 427 species may be indirectly affected by the use of the chemical. |
| Pyrethrins | From 2006 RED for Pyrethrins http://www.epa.gov/oppsrrd1/REDs/pyrethrins_red.pdf:<br><br>The preliminary risk assessment for endangered species indicates that RQs exceed endangered species LOCs for freshwater fish and invertebrates, and estuarine/marine fish and invertebrates. Further, potential indirect effects to any species dependent upon a species that experiences effects from use of pyrethrins can not be precluded based on the screening level ecological risk assessment. |
| Pyridalyl | From 2008 Fact Sheet for Pyridalyl http://www.epa.gov/opprd001/factsheets/pyridalyl.htm:<br><br>Potential risks that exceeded the endangered species LOC were identified for aquatic invertebrates and species that rely on aquatic invertebrates for survival or reproduction. In addition, potential risks that exceeded the endangered species LOC were identified for herbivorous and insectivorous birds and mammals. Based on pyridalyl proposed use as an insecticide, there is presumably risk to terrestrial invertebrates that also exceed the endangered species LOCs. Fish RQs were as high as 0.04. Multiple lines of evidence were used to estimate potential body burdens and risks to fish. RQs based on estimates from Arnot and Gobas |

| | |
|---|---|
| | (2004) methodology would not result in LOC exceedance (RQ = 0.01). RQs based on residue estimates using methodology from the Great Lakes Initiative (U.S. EPA, 1995) would result in endangered species LOC exceedance (RQ = 0.06 to 0.09). |
| Pyroxsulam | From EPA-HQ-OPP-2006-0785-0007, EFED Environmental Fate and Ecological Risk Assessment for Pyroxsulam http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a1615f:<br><br>Listed species acute risk LOCs for direct effects of pyroxsulam on semi-aquatic plants are exceeded for a single application for the proposed use of pyroxsulam with RQs ranging from3.44-68.33 for dicots and monocots, respectively. Listed species acute risk LOCs are exceeded forterrestrial monocot plants adjacent to treated areas. |
| Resmethrin | From 2006 RED for Resmethrin http://www.epa.gov/oppsrrd1/REDs/resmethrin_red.pdf:<br><br>The acute risk level of concern (LOC) (0.5) and acute endangered species LOC (0.05) are exceeded for freshwater fish exposed to resmethrin. The endangered species acute risk LOC (0.05) is exceeded for estuarine/marine fish exposed to formulated resmethrin (RQ 0.48) and estuarine/marine fish exposed to technical resmethrin (RQ = 0.07). The endangered species LOC (0.05) is slightly exceeded for freshwater invertebrates exposed to technical resmethrin (RQ range = 0.25 to 0.11). The acute endangered species LOC (0.05 is exceeded for estuarine/marine benthic organisms in water 1 foot, 1 meter, and 2 meters deep (RQs range from 0.05 to 0.26).<br><br>For the screening level assessment, potential risks to reptiles and terrestrial phase amphibians are estimated based on risks to birds; and potential risks to aquatic phase amphibians are estimated based on risks to freshwater fish. Because the screening level assessment shows potential risks for both birds and freshwater fish, the potential risks to reptiles, terrestrial phase amphibians, and aquatic phase amphibians cannot be precluded based on the screening level assessment. |
| Rotenone | From 2007 RED for Rotenone http://www.epa.gov/oppsrrd1/REDs/rotenone_red.pdf:<br><br>As a registered piscicide, rotenone is expected to kill fish and aquatic invertebrates at the concentrations at which it is applied.<br><br>Acute Risk<br>At maximum treatment concentrations, acute EECs of rotenone are expected to be equivalent to the solubility limit of 200 ppb. At this exposure concentration, risk quotient values (RQ = EEC/LC50) for fish and invertebrates are 103 |

| | |
|---|---|
| | (200/1.94) and 54 (200/3.7), respectively. Both RQs exceed the acute risk level of concern (RQ = 0.5). When used at the maximum treatment concentrations, rotenone is likely to cause the intended effect of acute mortality for many aquatic species in the treatment area.<br><br>Chronic Risk<br>Based on the dissipation rates, and the highest application rates in each type of site, effects might be expected on sensitive species for less than two weeks in warm water environments. However, rotenone can be quite persistent in cold environments where it might remain at levels causing effects for approximately 160 days at maximum labeled treatment concentrations. Chronic risk quotients (RQs) exceed the Agency's LOC. |
| S,S,S-tributyl phosphorotrithioate | From 2006 RED for S,S,S-tributyl phosphorotrithioate http://www.epa.gov/pesticides/reregistration/REDs/tribufos_red.pdf:<br><br>The acute endangered species LOC is exceeded at 1.875 lbs ai/A, and the 1.125 labs ai/A rate for birds foraging on short grass. The acute endangered species LOC is exceeded when mammals feed on large insects at both the 1.875 lbs ai/A rate and the 1.125 lbs ai/A rate. For estuarine and marine fish, the results indicate that the aquatic acute restricted use, and the acute endangered species LOCs are very slightly exceeded. For estuarine and marine invertebrates, the acute high risk LOC (0.5), the acute endangered species (0.05), the acute restricted use (0.1), and the chronic LOC (1.0) are exceeded for estuarine/marine invertebrates at an application rate of 1.875 lbs ai/A. |
| Sabadilla alkaloids | From 2004 RED for Sabadilla alkaloids http://www.epa.gov/oppsrrd1/REDs/sabadilla_red.pdf:<br><br>Risk assessments suggest risk concerns for endangered species (mammals) at the maximum application rates, but at the typical application rates, with shorter estimated half-lives, and longer intervals between applications, the endangered species risks were only slightly elevated, and only for small mammals (15 grams) feeding on short grass. |
| Sethoxydim | From 2005 RED for Sethoxydim http://www.epa.gov/oppsrrd1/REDs/sethoxydim_red.pdf:<br><br>The Agency's levels of concern is exceeded for direct chronic effects to birds, and effects to terrestrial and semi-aquatic monocots. Reptiles and terrestrial phase amphibians are not tested but are assumed to have potential effects similar to the effects observed in birds. |

| | |
|---|---|
| Siduron | From 2008 RED for Siduron http://www.epa.gov/oppsrrd1/REDs/siduron_red.pdf:<br><br>The Agency's screening-level assessment indicates the possibility of direct effects to listed aquatic plants, terrestrial and semi-aquatic monocot plants, semi-aquatic dicot plants, and insects. In addition effects to birds and mammals are expected for chronic exposure. While the RQ values for freshwater fish and marine/estuarine invertebrates exceed the listed-species LOC, based on the slope of the dose response curve, acute exposure to siduron is not likely to adversely affect these taxonomic groups. |
| Simazine | From 2006 RED for Simazine http://www.epa.gov/oppsrrd1/REDs/simazine_red.pdf:<br><br>The Agency's preliminary assessment indicates that the LOC for Listed Species is exceeded for the following combination of taxonomic groups: Freshwater fish, freshwater invertebrates, vascular aquatic plants, birds, mammals, and monocot and dicot terrestrial plants. |
| Sodium chlorate | From 2006 RED for Sodium chlorate http://www.epa.gov/oppsrrd1/REDs/inorganicchlorates_red.pdf:<br><br>The preliminary risk assessment for endangered species indicates that RQs exceed endangered species LOCs for chronic risks to birds (RQs up to 11 for agricultural uses and greater for non-agricultural uses); acute risks to mammals (RQs up to 33); chronic risks to mammals (RQs up to 1.2 for agricultural uses and greater for non-agricultural uses); and risks to aquatic plants (RQs up to 13). |
| Sodium cyanide | From 1994 RED for sodium cyanide, EPA-HQ-OPP-2007-0944-0007 http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480361375:<br><br>Sodium cyanide can be categorized as very highly toxic to birds based on the nature of the poison. Nontarget Mammals: Although the restrictions described above reduce the risk to nontarget terrestrial animals, nontarget kills will likely occur with the M-44 capsules.<br><br>The U.S. Fish and Wildlife Service issued a Biological Opinion in March, 1993 for sodium cyanide and other vertebrate pesticide chemicals. The specific Biological Opinion for sodium cyanide is included in Appendix G of this document. Jeopardy determinations were made for the Florida panther, jaguarundi, Louisiana black bear, ocelot, San Joaquin Kit fox, and California condor. |

| | |
|---|---|
| Spinetoram (XDE-175-L and XDE-175-J) | From 2007 EFED Ecological Risk assessment for Spinetoram http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a3956a:<br><br>Listed species potentially at direct risk from application of spinetoram include insects, mammals, and freshwater and estuarine/marine invertebrates (including benthic). All taxa are at risk from indirect effects due to adverse effects to prey source or pollinators. |
| Spirodiclofen | From 2005 Fact Sheet for Spirodiclofen http://www.epa.gov/opprd001/factsheets/spirodiclofen.pdf:<br><br>Based on the screening level analyses conducted, the Agency's acute levels of concern for endangered species is exceeded for freshwater and estuarine/marine fish and freshwater invertebrates. The LOC for endangered species were also exceeded for amphibians, mammals, and insects. |
| Spirotetramat | From 2008 Fact Sheet for Spirotetramat http://www.epa.gov/opprd001/factsheets/spirotetramat.pdf:<br><br>Potential for direct effects on terrestrial invertebrates, birds, terrestrial amphibians, and reptiles. Potential for indirect effects on terrestrial and semi-aquatic plants (monocots and dicots), terrestrial invertebrates, birds, terrestrial amphibians, and reptiles, mammals, aquatic plants (vascular and non-vascular), fish, aquatic amphibians, aquatic invertebrates. |
| Sulfosulfuron | From EPA-HQ-OPP-2009-0081-0034, EFED Ecological Risk Assessment for Sulfosulfuron http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480924093:<br><br>Based on the available ecotoxicity information and the estimated enviromental exposures, direct effects LOCs for risk were exceeded for terrestrial monocots and dicots and aquatic vascular plants. Therefore, there is potential for indirect effects to all terrestrial animal taxa that depend on those plants for habitat, feeding, or cover requirements, and for survival, growth, or reproduction. This includes honeybees, birds and reptiles, terrestrial-phase amphibians, mammals, freshwater invertebrates, fish, aquatic-phase amphibians, and estuarine/marine fish and invertebrates. |
| Tebufenozide | From EPA-HQ-OPP-2008-0824-0004 for Tebufenozide http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2004-0143#documentDetail?R=09000064807b2488:<br><br>From EPA-HQ-OPP-2008-0824-0004, Registration Review Problem Statement Tebufenozide was initially registered for use on walnuts and pecans in 1994. In |

| | |
|---|---|
| | February 1999, the Agency completed a screening- level ecological risk assessment of the Section 3 Registration on pome fruit, cotton, walnuts, cole crops and leafy vegetables, sugarcane, fruiting vegetables, forests, trees, shrubs and ornamentals. The risk assessment concluded the proposed uses of tebufenozide did not appear to present an acute or chronic risk to freshwater and estuarine/marine fish or invertebrates associated with the water column; however, aquatic invertebrates in the benthic sediment may be affected. Additionally, there was a low likelihood of direct acute risk to birds, terrestrial-phase amphibians, reptiles and mammals; however, risk of direct chronic reproductive effects in terrestrial animals was identified. No data were available to assess the toxicity of tebufenozide to terrestrial plants. |
| Tembotrione | From 2007 Fact Sheet for Tembotrione http://www.epa.gov/opprd001/factsheets/tembotrione.pdf:<br><br>LOCs were exceeded for listed aquatic non-vascular plants (RQ = 1-3.2 depending on scenario). LOCs were exceeded for non-listed (dicot RQ = 12.62) and listed terrestrial plants (dicot RQ = 27.33). LOCs were exceeded for non-listed (monocot RQ = 1.49; dicot RQ = 107.23) and listed (monocot RQ = 3.8; dicot RQ = 232.33) semi-aquatic plants. Because there are direct effects to plants, any listed species depending on these taxa may experience indirect effects.<br><br>Acute LOCs were exceeded for non-listed and listed estuarine/marine invertebrates for the Florida corn scenario. Chronic LOCs were exceeded for non-listed and listed estuarine/marine invertebrates in the Florida, North Carolina, Mississippi, and Texas scenarios. LOCs were exceeded for chronic risk to mammals based on body weight gain and corneal opacity data. |
| Temephos | From 2000 RED for Temephos http://www.epa.gov/oppsrrd1/REDs/temephos_red.htm:<br><br>The Risk Quotients derived from the current freshwater fish acute toxicity studies exceed the levels of concern for the emulsifiable concentrate formulation only for restricted use and endangered species, the risk quotients for the granular formulation do not exceed the levels of concern. Additionally, due to the tendencies for temephos to bioconcentrate, a piscivorous bird scenario was modeled to assess the risk to fish-eating birds. This assessment indicates that only endangered species RQs may be exceeded in the 15 cm pond depth scenario. |
| Terbufos | From 2006 RED for Terbufos http://www.epa.gov/pesticides/reregistration/REDs/terbufos_red.pdf:<br><br>The Agency has initiated three consultations with the Fish and Wildlife Service (FWS) on the potential effects of terbufos corn use on endangered and threatened species. To date, the FWS has issued two Biological Opinions. In these Opinions, the FWS found jeopardy for 13 fish species, 25 aquatic invertebrate species, and |

| | |
|---|---|
| | 4 insect species. An additional 15 fish species and 2 aquatic invertebrate species were expected to be affected, but not jeopardized. The FWS also found jeopardy for one avian species due to the potential effects of reducing its aquatic food source. |
| Terbuthylazine | From 1994 RED for Terbuthylazine http://www.epa.gov/oppsrrd1/REDs/2645.pdf:<br><br>No significant risk is expected for terrestrial avian endangered species since the level of concern is not exceeded. A risk to endangered freshwater and estuarine/marine organisms is expected from the high exposure scenario. The Level of Concern for the high exposure scenario is exceeded. Even though no data are available on non-target plants, if exposed, endangered aquatic would presumably be at risk for the reasons presented above. The nature of this chemical and the label warning indicate phytotoxicity. |
| Terrazole (etridiazole) | From 2000 RED for Terrazole http://www.epa.gov/oppsrrd1/REDs/0009red.pdf:<br><br>There are risks to federally listed endangered and threatened birds, mammals, aquatic plants and freshwater and estuarine fish and invertebrates from single and multiple applications of etridiazole to turf. |
| Tetraconazole | From 2006 EFED Risk Assessment for Tetraconazole http://www.epa.gov/opprd001/factsheets/tetra_efed_ra.pdf:<br><br>Chronic LOC's are exceeded for mammals consuming short grass, tall grass, and broadleaf plants and insects. On a single-oral dose exposure basis for birds, the Acute Endangered LOC is exceeded for small and medium-sized birds exposed via short grass, tall grass, broadleaf plants and small insects. On a dietary exposure basis, the Acute Endangered LOC is exceeded for birds consuming short grass only. The Chronic<br>LOC's are exceeded for birds via short and tall grass, broadleaf plants, and small insects. |
| Tetramethrin | From 2008 RED for Tetramethrin http://www.epa.gov/oppsrrd1/REDs/tetramethrin-red.pdf:<br><br>No direct or indirect effects to endangered species are expected due to applications of tetramethrin, except the potential for direct effects for Listed insects or indirect effects to plants if they have an obligate relationship with a Listed insect pollinator. |

| | |
|---|---|
| Thiacloprid | From 2003 Fact Sheet for Thiacloprid http://www.epa.gov/opprd001/factsheets/thiacloprid.pdf:<br><br>There is concern for risk to marine/estuarine invertebrate species, both acute (all the proposed uses) and chronic ( for apple and cotton uses). There is concern for chronic risks to birds for all the proposed uses. There is concern for acute risks to only the very smallest sized mammal species for all the proposed uses, and chronic risks to all small mammals for all the proposed uses. |
| Thidiazuron | From 2005 RED for Thidiazuron http://www.epa.gov/oppsrrd1/REDs/thidiazuron_red.pdf:<br><br>The Agency's screening level risk assessment for listed species indicates that thidiazuron exceeds the endangered species levels of concern for endangered and threatened terrestrial and semi-aquatic dicots, and exceeds chronic levels of concern for certain mammals. |
| Thiencarbazone-methyl (TCM) | From EPA-HQ-OPP-2008-0132-0008 for Thiencarbazone-methyl http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480a1890d:<br><br>This risk assessment indicates that TCM poses risk of decreasing biomass of plants in aquatic and terrestrial habitats at levels that exceed the Agency's LOCs. Potential direct adverse effects to plants could lead to risks of indirect effects to animals that depend upon plants for food and for shelter. The potential risks of direct effects to plants and resulting indirect effects to animals are relevant to all species located within the United States and its territories located near locations of potential use sites, including those that are listed as Federally endangered and threatened. Direct effects to plants and indirect effects to animals that depend upon plants could occur at distances as far as 2100 feet from the edge of the field where TCM is applied. Although a full endangered species assessment has not been conducted for these uses, direct effects to listed species of plants cannot be precluded at distances beyond 2100 feet from the edge of the field where TCM is applied. |
| Thiobencarb | From 1997 RED for Thiobencarb http://www.epa.gov/oppsrrd1/REDs/2665red.pdf:<br><br>The above risk assessment indicates that use of thiobencarb on rice poses a risk to threatened and endangered species (TES) of birds, mammals, fish, and aquatic invertebrates (including crustaceans and mollusks). Use of thiobencarb on rice also poses a risk to T & E species of plants. |

| | |
|---|---|
| Thiodicarb | From 1998 RED for Thiodicarb<br>http://www.epa.gov/oppsrrd1/REDs/2675red.pdf:<br><br>Endangered species LOCs are exceeded for most terrestrial and aquatic (freshwater and marine) species and uses of thiodicarb and its degradate methomyl. Thiodicarb may result in chronic risks to certain species that frequent short grass (e.g, ducks, geese and swans). Both thiodicarb and its degradate methomyl canpresent high acute risk to freshwater and marine invertebrates. Chronic risk to aquaticinvertebrates may result from thiodicarb in corn and cotton uses and from methomyl in all uses. |
| Thiophanate-methyl | From 2005 RED for Thiophanate-methyl<br>http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf:<br><br>EPA's ecological risk assessment suggests that TM/MBC is expected to pose a chronic risk to endangered birds, mammals, aquatic animals, and aquatic plants under most of the registered use scenarios. |
| Thiram | From 2004 RED for Thiram<br>http://www.epa.gov/oppsrrd1/REDs/0122red_thiram.pdf:<br><br>The chronic risk quotients (RQs) for birds including endangered species that exceed levels of concern (LOCs) range from 26 to 1,237. There is a chronic effect to mammals including endangered species, which results in RQs that range from 3.9 to 6,250. Acute RQs for fish and aquatic invertebrates including endangered species range from 0.1 to 28. |
| Tralkoxydim | From EPA-HQ-OPP-2009-0081-0069, EFED Review of Tralkoxydim<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064809240b7:<br><br>Acute risk levels of concern for parent tralkoxydim are exceeded for non-target and endangered terrestrial plant species when exposed to drift from aerial application. The LOCs for plants were exceeded by a very small factor. Minimal acute effects to birds, aquatic plants, freshwater invertebrates or fish and minimal chronic effects to birds and aquatic fish and invertebrates from tralkoxydim are expected. However, acute freshwater invertebrate and fish studies are being requested on the tralkoxydim acid since its environmental fate characteristics indicate a potential to accumulate in the aquatic environment. |
| Triadimefon | From 2006 RED for Triadimefon<br>http://www.epa.gov/oppsrrd1/REDs/triadimefon_red.pdf:<br><br>The assessment indicates that triadimefon has the potential for causing risk to endangered birds, mammals, and non-target plants. |

| | |
|---|---|
| Triallate | From 2000 RED for Triallate<br>http://www.epa.gov/oppsrrd1/REDs/2695.pdf:<br><br>Levels of concern are slightly exceeded for endangered small mammals. Levels of concern for acute risk, based on water modeling results, are slightly exceeded for endangered aquatic invertebrates. Additionally, levels of concern for acute risk are exceeded for terrestrial and semiaquatic plants. |
| Tributyltin benzoate | From EPA-HQ-OPP-2008-0171-0007 for Tributyltin benzoate<br>http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480408499:<br><br>The acute-risk LOC is equaled or exceeded only for listed (e.g., endangered and threatened) freshwater and estuarine/marine invertebrates exposed in the water column.<br><br>The assessment for wood treatment uses indicates that there is a potential for TBT exposure of listed freshwater and estuarine/marine organisms, and possibly terrestrial birds and mammals. |
| Trichlorfon | From 2006 RED for Trichlorfon<br>http://www.epa.gov/pesticides/reregistration/REDs/0104.pdf:<br><br>Acute and chronic LOCs are exceeded for non-endangered species (birds and mammals), and therefore are also exceeded for endangered species. Acute LOCs are exceeded for non-endangered species (freshwater, estuarine, and marine fish and invertebrates), and therefore are also exceeded for endangered species. By the same reasoning, chronic levels of concern are exceeded for aquatic invertebrates (freshwater, marine, and estuarine). |
| Triclopyr, salts and esters | From 1998 RED for Triclopyr, salts and esters<br>http://www.epa.gov/oppsrrd1/REDs/2710red.pdf:<br><br>Endangered species LOCs are exceeded for triclopyr TEA for birds, mammals and for aquatic and terrestrial plants. Endangered species LOCs are exceeded for triclopyr BEE for birds, mammals, fish, aquatic invertebrates, estuarine species and aquatic and terrestrial plants. |
| Triclosan | From 2008 RED for Triclosan<br>http://www.epa.gov/oppsrrd1/REDs/2340red.pdf:<br><br>An ecological risk assessment is not typically conducted for the types of triclosan uses registered with the EPA because of the limited potential for ecological exposure. However, since triclosan has been detected in natural waters, a qualitative environmental risk assessment was performed using monitoring levels of triclosan found in waterways and toxicity values from the tables in section I of |

| | |
|---|---|
| | the Ecological Hazard and Environmental Risk Assessment Science Chapter for the Triclosan Reregistration Eligibility Decision (RED) Document, dated September 11, 2008 to develop risk quotients (RQs) and compare them to levels of concern (LOCs) for triclosan. LOCs were not exceeded for fish but were exceeded for aquatic plants. The RQs were based on published literature, submitted data and USGS monitoring data. A meta-analysis of literature, plus exposure modeling was used to conduct a probabilistic assessment of triclosan. There were no acceptable acute toxicity studies for freshwater invertebrates or estuarine and marine organisms nor were there any acceptable chronic toxicity studies available for aquatic organisms. Therefore, risk to these species could not be assessed at this time. The hazard assessment will be used to meet current labeling needs and to determine hazard endpoints for ecological organisms potentially exposed in the event of a spill or other potential environmental releases. |
| Triflumizole | From EPA-HQ-OPP-2006-0115-0003 for Triflumizole http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648021849d:<br><br>Endangered species LOCs are exceeded on an acute basis for freshwater fish. Highly toxic to eastern oyster and mysid shrimp. |
| Trifluralin | From 1996 RED for Trifluralin http://www.epa.gov/oppsrrd1/REDs/0179.pdf:<br><br>The endangered species LOCs have been exceeded for birds, mammals, and semi-aquatic plants. Although the LOCs have not been exceeded for endangered freshwater and marine or estuarine fish, these species may be adversely affected based on laboratory and field studies which revealed vertebral dysplasia after exposure to very low levels of trifluralin. |
| Vinclozolin | From 2000 Fact Sheet for Vinclozolin http://www.epa.gov/oppsrrd1/REDs/factsheets/2740fact.pdf:<br><br>The risk assessment for vinclozolin indicates low levels of acute risk to wildlife. The Agency's level of concern has been exceeded for chronic effects to avian species for most use sites. For turfgrass, the highest RQ is 2.7, which is slightly above the LOC of 1.0 [for non-endangered species]. Chronic risk to aquatic organisms has not been assessed due to lack of data. |
| Warfarin | From EPA-HQ-OPP-2006-0955-0764 (Revised Rodenticide Cluster RED) http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=EPA-HQ-OPP-2006-0955-0764:<br><br>EPA’s comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when |

| | |
|---|---|
| | applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. In March 2005, EPA initiated informal consultation for the nine rodenticides registered at that time. Several reported incidents have involved Federally listed threatened and endangered species, for example the San Joaquin kit fox and Northern spotted owl, in addition to the Bald eagle, which is protected under the Bald and Golden Eagle Act. The FWS issued a biological opinion on eight of the rodenticides in 1993.The USFWS in 1993 determined that warfarin would put 10 mammalian species in jeopardy. |
| Zinc Phosphide | From 1998 RED for Zinc phosphide<br>http://www.epa.gov/oppsrrd1/REDs/0026red.pdf:<br><br>Zinc phosphide was addressed in the "U. S. Fish and Wildlife Service Biological Opinion March, 1993" document. The Service made a "jeopardy" determination for 35 species that were determined to be potentially exposed from these uses. Of these 35 species, 29 (20 mammalian, 9 avian) were determined to be in a "jeopardy" status. |
| Ziram | From 2003 RED for Ziram<br>http://www.epa.gov/oppsrrd1/REDs/ziram_red.pdf:<br><br>Endangered species LOCs for Ziram are exceeded for acute risk to herbivorous and insectivorous birds and mammals from single and multiple applications to pome fruits, stone fruits and nut crops as well as herbivorous birds and mammals plus insectivorous mammals from single and multiple applications to vegetable crops and grape. In addition the chronic LOC is exceeded for endangered mammals from single and multiple applications to all uses of Ziram. Acute LOCs for endangered freshwater fish and invertebrates, including mollusks and crustaceans, were exceeded for all uses of Ziram. Based on the available avian data, there is also a potential for risk to endangered reptiles from the uses of Ziram. |
| Zoxamide | From 2001 Fact Sheet for Zoxamide<br>http://www.epa.gov/opprd001/factsheets/zoxamide.pdf:<br><br>The Agency's level of concern for endangered and threatened freshwater fish and estuarine/marine invertebrates is slightly exceeded for the proposed use of zoxamide on grapes and potatoes. |

## 5. Category 3 Pesticides

Category 3 pesticides are those for which the EPA has not conducted an ecological assessment, nor are there acute toxicity data in the EPA AQUIRE, Terretox, or OPP Ecotox databases, but for which other data exist in EPA's hazard assessments, the open literature, or in Material Safety Data Sheets (MSDSs) indicating high acute or chronic toxicity to one or more taxa groups. The following table presents excerpts from these documents that highlight these concerns. Common abbreviations used include:

| | |
|---|---|
| EC50 | Concentration that causes an effect in 50% of a species population, determined by laboratory tests. |
| EEC | Expected environmental concentration |
| EFED | U.S. EPA's Environmental Fate and Effects Division |
| GENEEC | GEEneric Expected Environmental Concentration program, EPA's Tier 1<br>screening level assessment tool used to model water contamination |
| LC50 | Concentration that is lethal to 50% of a species population, determined by laboratory tests. |
| LOC | Level of concern |
| MSDS | Material Safety Data Sheet |
| OSHA | Occupational Safety and Health Administration |
| RED | Reregistration Eligibility Decision document |
| RQ | Risk quotient, the ratio of the EEC to the concentration of concern for a particular taxa group. |
| USFWS | U.S. Fish and Wildlife Service, also abbreviated FWS |

| Pesticide | Statements Indicating High Toxicity for One or More Taxa Groups |
|---|---|
| Alpha-chlorohydrin | From EPA 2006 Fact Sheet for Alpha-chlorohydrin http://www.epa.gov/opprd001/factsheets/alphachlorohydrin_epibloc.pdf:<br><br>(Not evaluated in rodenticide cluster assessment.)<br>Epibloc will be lethal or will sterilize rats at sublethal doses, outdoor applications have a potential for similar adverse effects to nontarget mammals and birds, including listed (endangered and threatened) species.. |
| Chromic acid | From http://www.environment.gov.au/atmosphere/airquality/publications/sok/chromium.html:<br><br>Chromium (VI) can have high to moderate acute toxic effect on plants, birds and land animals. This can mean the death of animals, birds and fish and either death or low growth rate in plants. Chromium (VI) does not break down or degrade easily; there is a high potential for accumulation of chromium (VI) in fish life. |

| | |
|---|---|
| | From http://www.elementischromium.com/pdf/ChromicAcid_2001.pdf:<br><br>This product is toxic to wildlife and aquatic invertebrates.<br><br>From http://www.sciencelab.com/xMSDS-Chromic_Acid_10_-9925764:<br><br>Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (effects on fertility: fetotoxicity or post-implantation mortality) and birth defects.<br><br>From http://www.evol.nw.ru/~spirov/hazard/chromium%28vi%29oxide.html:<br><br>Chromium (VI) has high acute toxicity to aquatic life. |

| | |
|---|---|
| Dimethomorph | From U.S. EPA 1998 Fact Sheet for Dimethomorph http://www.epa.gov/opprd001/factsheets/dimethomorph.pdf:<br><br>Risk quotients for avian organisms were estimated for four scenarios distinguished by categories of food items that birds eat: short grass, tall grass, broadleaf plants and fruits. The chronic LOC trigger for multiple broadcast applications of dimethomorph is marginally exceeded under the short grass scenario if no degradation is assumed. |
| Fluridone | From New York Pest Management Education Program web site http://pmep.cce.cornell.edu/profiles/herb-growthreg/fatty-alcohol-monuron/fluridone/herb-prof-fluridone.html:<br><br>Acute and Maximum Acceptable Toxicant Concentration (MATC) values indicate a potential hazard for aquatic organisms in shallow areas at higher treatment rates described on the label. Formal consultation with Office of Endangered Species (OES) has been initiated. To minimize hazard, label directions provide for use of lowest listed rates for shallow areas, and consultation with Fish and Game Agency or U.S. Fish and Wildlife Service if questions arise concerning aquatic resources in the area to be treated.<br><br>From http://www.ecy.wa.gov/programs/wq/plants/management/FluridoneStrategies.html:<br><br>While there is no direct toxicity of fluridone to animals, the loss of habitat does cause indirect impacts.<br><br>From http://pdfserve.informaworld.com/679869_770849120_713993104.pdf:<br><br>Haag & Buckingham (1991) found *Bagous affinis*, a weevil biocontrol agent of |

| | |
|---|---|
| | Hydrilla verticillata was not killed by diquat/copper, fluridone or endothall. The same herbicides caused high mortality to larvae of Hydrellia pakistanae, apparently due to destruction of plants they were feeding in. |
| Halofenozide | From MSDS for Mach* 2 2SC Insecticide containing Halofenozide: http://www.cdms.net/LDat/mp6PE002.pdf:<br><br>Based on information for halofenozide. Material is highly toxic to aquatic organisms on an acute basis (LC50 or EC50 between 0.1 and 1 mg/L in the most sensitive species tested). |
| Mandipropamide | From 2007 U.S. EPA EFED Risk Assessment for Mandipropamide: http://www.regulations.gov/search/Regs/home.html#documentDetail?R=090000648037c6cf:<br><br>The registrant submitted aquatic invertebrate acute toxicity studies demonstrating that technical mandipropamid is moderately toxic to freshwater invertebrates and very highly to moderately toxic to marine/estuarine invertebrates. |
| Metaflumizone | From CA Department of Pesticide Regulation Public Report 2008-1 on AI Metaflumizone http://cdpr.ca.gov/docs/registration/ais/publicreports/5935.pdf:<br><br>Metaflumizone is highly toxic to fish, oysters, and mysid shrimp. |
| Methyl iodide | From EPA-HQ-OPP-2005-0252-0005 Human Health Risk Assessment for Methyl iodide http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480109aaf:<br><br>The pattern of toxicity attributed to iodomethane exposure via the inhalation route includes developmental toxicity (manifested as fetal losses and decreased live births), histopathology findings (respiratory tract lesions and salivary gland squamous cell metaplasia ), thyroid toxicity, neurotoxicity and generalized systemic toxic effects (body weight and body weight gain decreases). |
| Phosphine | From U.S. EPA 1999 Fact Sheet: for Phosphine http://www.epa.gov/opprd001/factsheets/phosphine.pdf:<br><br>Phosphine would be highly toxic to small mammals and birds that might remain in indoor sites (e.g., warehouses) during fumigation.<br><br>From INCHEM Pesticide Data Summary: http://www.inchem.org/documents/pds/pds/pest46_e.htm<br><br>A gas of very high mammalian toxicity which affects the gastrointestinal tract |

| | |
|---|---|
| | and central nervous system, without cumulative effect.<br><br>Frog LC50: 0.56 mg/l for 30 minutes, 0.84 mg/l for 15 minutes |
| Sodium bichromate dihydrate | From http://www.environment.gov.au/atmosphere/airquality/publications/sok/chromium.html:<br><br>Chromium (VI) can have high to moderate acute toxic effect on plants, birds and land animals. This can mean the death of animals, birds and fish and either death or low growth rate in plants. Chromium (VI) does not break down or degrade easily; there is a high potential for accumulation of chromium (VI) in fish life.<br><br>From http://www.elementischromium.com/pdf/ChromicAcid_2001.pdf:<br><br>This product is toxic to wildlife and aquatic invertebrates.<br><br>From http://www.sciencelab.com/xMSDS-Chromic_Acid_10_-9925764:<br><br>Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (effects on fertility: fetotoxicity or post-implantation mortality) and birth defects.<br><br>From http://www.evol.nw.ru/~spirov/hazard/chromium%28vi%29oxide.html:<br><br>Chromium (VI) has high acute toxicity to aquatic life. |
| Sodium Tetrathiocarbonate | From EPA-HQ-OPP-2007-1084-0002, U.S. EPA Registration Review Summary Document for Sodium tetrathiocarbonate http://www.regulations.gov/search/Regs/home.html?main=DocketDetail&d=EPA-HQ-OPP-2007-0146#documentDetail?R=090000648037b4db:<br><br>Sodium tetrathiocarbonate degrades to carbon disulfide ($CS_2$), hydrogen sulfide ($H_2S$), sodium hydrazide, and elemental sulfur upon contact with water. CS2 (PC code 016401) is the major biologically active degradate. Carbon disulfide, when produced by degradation of sodium tetrathiocarbonate used in accordance with the label, results in potential adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms.<br><br>From OSHA Health Guidelines: http://www.osha.gov/SLTC/healthguidelines/carbondisulfide/recognition.html<br><br>Carbon disulfide exposure by inhalation causes significant toxicity to the brain, spleen, liver, and testes, and irritation of the intestinal tract in experimental animals [ACGIH The oral LD(50) in rats is 3,188 mg/kg, and the 2-hour LC(50) in rats is 25 gm/m(3) [NIOSH 1991]. Dogs exposed chronically to carbon disulfide showed behavioral changes, became aggressive, and developed |

| | |
|---|---|
| | uncontrolled movements [Klaasen 1986]. Reproductive toxicity, embryotoxicity, and developmental effects were found after pregnant rats were exposed to approximately 33 ppm mg/m(3)) for 8 hours ()on days 1 to 21 of gestation [NIOSH 1991].<br><br>From MSDS for Carbon disulfide http://www.jtbaker.com/msds/englishhtml/c0957.htm:<br><br>Carbon disulfide is a known human reproductive hazard. Menstrual disorders, spontaneous abortions and premature births are reported in cases of chronic exposure. |
| Triticonazole | From MSDS for Trinity product, containing Triticonazole http://www.cdms.net/ldat/mp84K003.pdf:<br><br>Potential environmental effects of the active ingredient.<br>Aquatic toxicity:<br>Acutely toxic for fish.<br>Acutely toxic for aquatic invertebrates.<br>Acutely toxic for aquatic plants.<br><br>Terrestrial toxicity:<br>Acutely toxic to terrestrial organisms.<br>Very acutely toxic to honeybees. |

## VIOLATIONS

### A. EPA is in Violation of Section 2 and Section 7 of the ESA

The Endangered Species Act was enacted, in part, to provide a "means whereby the ecosystems upon which endangered species and threatened species depend may be conserved . . . [and] a program for the conservation of such endangered species and threatened species . . . ."[218] In *TVA v. Hill*, the Supreme Court noted that the ESA "reveals an explicit congressional decision to require agencies to afford first priority to the declared national policy of saving endangered species."[219]

Section 2(c) of the ESA establishes that it is "the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."[220] The ESA defines "conservation"

[218] 16 U.S.C. § 1531(b)

[219] *TVA v. Hill*, 437 U.S. 153, 183 and 185 (1978)

[220] 16 U.S.C. § 1531(c)(1)

to mean "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."[221]

When a species has been listed as threatened or endangered under the ESA, federal agencies have the obligation to assess and bring their programs and activities into compliance with the ESA. These duties fall into two categories. First, under section 7(a)(1) of the ESA, federal agencies such as the EPA must "utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of endangered species and threatened species listed" under the statute.[222] Second, under Section 7(a)(2), federal agencies are required to engage in consultation with FWS (and/or NMFS) to "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 adverse modification of habitat of such species . . . determined . . . to be critical . . . ."[223] Section 7 consultation is required for "any action [that] may affect listed species or critical habitat."[224]

As discussed above, prolific scientific evidence establishes that use of registered pesticides can, in multiple ways, adversely affect listed species and their habitat. Consequently, pursuant to section 2 and section 7 of the ESA, EPA must use its authority to regulate pesticide use in the United States so as to avoid the adverse impacts of pesticides to endangered and threatened species. EPA has failed to do so. Moreover, EPA must satisfy its duty to avoid jeopardizing listed species, or adversely modifying their critical habitat, by initiating the consultation process for its actions in registering these pesticides and, where appropriate, by conforming its pesticide registration actions to a biological opinion issued by the FWS or NMFS following formal consultation,[225] and by fully complying with any reasonable and prudent alternatives and measures set forth in such biological opinion. EPA has failed to take these actions.

Attached to this NOI, as Exhibit A, are charts identifying threatened and endangered species and the registered pesticides whose concentrations in the environment may exceed LOCs to those species and/or that are "highly" to "very highly" toxic to those species. The pesticides included in Chart 1 may exceed Levels of Concern for mammals and/or are "highly" to "very highly"

---

[221] 16 U.S.C. § 1532(3)

[222] 16 U.S.C. § 1536(a)(1); *See also Fla. Key Deer v. Paulison*, 522 F.3d 1133, 1146 (11th Cir. 2008) ("section 7(a)(1) imposes a judicially reviewable obligation upon all agencies to carry out programs for the conservation of endangered and threatened species")

[223] 16 U.S.C. § 1536(a)(2)

[224] 50 C.F.R. § 402.14

[225] As already described in the background section, the consultation obligations of the ESA apply to the EPA's registration and approval of pesticides under FIFRA. *Wash. Toxics Coalition v. EPA*, 413 F.3d at 1032 ("We agree with the Eighth Circuit that even though EPA registers pesticides under FIFRA, it must also comply with the ESA when threatened or endangered species are affected."); *Id*. at 1033 ("EPA retains ongoing discretion to register pesticides, alter pesticide registrations, and cancel pesticide registrations. Because EPA has continuing authority over pesticide regulation, it has a continuing obligation to follow the requirements of the ESA.")

toxic to mammals and therefore "may affect" the endangered and threatened mammalian species listed in Chart 1. The pesticides included in Chart 2 may exceed LOCs for birds and/or are "highly" to "very highly" toxic to birds and therefore "may affect" the endangered and threatened avian species listed in Chart 2. The pesticides included in Chart 3 may exceed LOCs for fish and/or are "highly" to "very highly" toxic to fish and therefore "may affect" the endangered and threatened fish species listed in Chart 3. The pesticides listed in Chart 4 may exceed LOCs for amphibians and/or are "highly" to "very highly" toxic to amphibians and therefore "may affect" the endangered and threatened amphibian species listed in Chart 4. The pesticides listed in Chart 5 may exceed LOCs for mollusks and/or are "highly" to "very highly" toxic to mollusks and therefore "may affect" the endangered and threatened mollusk species listed in Chart 5. The pesticides listed in Chart 6 may exceed LOCs for crustaceans and/or are "highly" to "very highly" toxic to crustaceans and therefore "may affect" the endangered and threatened crustacean species listed in Chart 6. The pesticides listed in Chart 7 may exceed LOCs for insects and/or are "highly" to "very highly" toxic to insects and therefore "may affect" the endangered and threatened insect species listed in Chart 7. The pesticides listed in Chart 8 may exceed LOCs for plants and/or are "highly" to "very highly" toxic to plants and therefore "may affect" the endangered and threatened plant species listed in Chart 8. The pesticides listed in Chart 9 may exceed LOCs for reptiles and/or are "highly" to "very highly" toxic to reptiles and therefore "may affect" the endangered and threatened reptile species listed in Chart 9. For each of these pesticides, EPA must conduct an effects determination and, if necessary, initiate consultation with the appropriate wildlife agency (FWS or NMFS).

### B. EPA Has Failed to Reinitiate Consultation and Has Failed to Implement Previous Biological Opinions

In addition to EPA's failure to consult regarding the vast majority of pesticides, EPA has likewise failed to reinitiate consultation for species/pesticides previously addressed in consultations. Moreover, for those species covered in previous BiOps, EPA is not meeting its section 7 "no jeopardy" obligations because EPA is not properly implementing the terms and conditions required by the previous BiOps.

The section 7 consultation regulations require re-initiation of consultation when discretionary federal involvement or control over the action has been retained and: (a) the amount or extent of the take specified in the incidental take statement is exceeded; (b) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; or (c) the identified action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion.[226] All three situations exist here.

First, as explained above in the background section, a great deal of new information exists regarding the impacts of pesticides on wildlife and plants. In fact, EPA's own documents confirm that new information demonstrates the serious potential for significant harm or death to

[226] 50 C.F.R. § 402.16; *Envtl. Prot. Info. Ctr. v. Simpson Timber Co.*, 255 F.3d 1073, 1076 (9th Cir. 2001) ("The duty to reinitiate consultation lies with both the action agency and the consultation agency.")

listed species from pesticides.[227] Moreover, pesticides previously consulted on are now being used in new and/or different manners than that considered at the time of review.

Second, a recent FOIA response from EPA (attached as Exhibit E) shows that EPA has failed to ensure the implementation of the RPMs and/or RPAs associated with the 1989 and 1993 pesticide BiOps. Thus, EPA does not know how much take has occurred and continues to occur, nor whether applicators are adhering to the RPAs/RPMs. Consequently, EPA must reinitiate consultation given that is has unable to identify, in any regard, what the past and current amount or extent of take is for species covered by the 1989 or 1993 BiOps.

Third, because of EPA's failure to implement the terms and conditions of the 1989 and 1993 BiOps, "the identified action [has been] modified in a manner that causes an effect to the listed species that was not considered in the biological opinion."[228] As stated in *Forest Guardians v. Johanns*,[229] "[i]t is the action agency's burden to show the absence of likely adverse effects on listed species." In *Forest Guardians*, re-initiation of consultation was deemed necessary because "[t]he material inadequacy of the Forest Service's utilization monitoring and the results of the limited measurements that were taken constituted modifications . . . in a manner and to an extent not previously considered."[230] The Court noted that while it does "not hold that each isolated instance in which the [action agency] deviate[s] from . . . guidance criteria require[s] the agency to re-initiate consultation, . . . the case before us is not comprised of infrequent and insignificant deviations."[231] The situation here presents similar circumstances. As shown by the recent FOIA response, EPA has failed to take any action to (1) identify the level of take occurring pursuant to the BiOps and (2) ensure compliance with the reasonable and prudent alternatives required by the 1989 and 1993 BiOps.[232] By failing to ascertain the level of take and whether the BiOps' RPAs and RPMs are being followed, the anticipated action assumed in the BiOps cannot be assumed. As a result, the action has deviated from that assessed in the BiOp and requires reinitiation.

Finally, EPA's failure to ensure the implementation of the RPMs and/or RPAs associated with the 1989 and 1993 BiOps means that EPA is ignoring its ESA section 7 duty to avoid jeopardizing any listed species. The FOIA response (exhibit E) divulges that the only document in EPA's possession regarding the implementation of the RPAs/RPMs for the 1989 and 1993 BiOps is a 1996 FWS amendment to the RPAs/RPMs for the 1993 BiOp which endorses

---

[227] *See, e.g., Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: a Comparative Approach* (July 2004); *Risk Mitigation Decision for Ten Rodenticides*, (May 2008)

[228] 50 C.F.R. § 402.16

[229] 450 F.3d 455, 463 (9th Cir. 2006)

[230] *Id*.

[231] *Id*. at 465-466

[232] *See also* Mary Jane Angelo, *The Killing Fields: Reducing the Casualties in the Battle Between U.S. Endangered Species and Pesticide Law,* 32 Harv. Envtl. L. Rev. 95 (2008)

measures provided in bulletins. This indicates that EPA has failed to take any steps to ensure compliance with the measures imposed by the 1989 and 1993 BiOps. Moreover, EPA's website explicitly states that county bulletins "are not enforceable pesticide use limitations," which likewise demonstrates that EPA is not complying with the RPAs/RPMs. In short, the terms and conditions of the 1989 and 1993 BiOps are not being enforced, or even monitored, and consequently, EPA is failing to ensure that its authorizations of pesticide use are not jeopardizing ESA listed species.[233]

### C. EPA's Registration of Pesticides Has Resulted in the Illegal "Take" of Listed Species

Section 9 of the ESA prohibits any person, including federal agencies, from taking any endangered or threatened species.[234] The term "take" is defined broadly to include "harass, harm, pursue, hunt, shoot, wound, trap, kill, capture, or collect, or to attempt to engage in any such conduct."[235] "Harm" is further defined as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[236] Thus, an action which indirectly (e.g. habitat modification) or directly causes a decline in the population of an endangered species harms that species. Additionally, any action that precludes the recovery of an endangered species also falls within the meaning of harm.

Federal agencies may be limitedly exempt from the take prohibition through the issuance of an Incidental Take Statement ("ITS") as part of a Biological Opinion.[237] The ITS must identify the expected impacts of the authorized take, the reasonable and prudent measures necessary to minimize those impacts, and the terms and conditions that the agency must comply with to adequately implement those measures.[238]

---

[233] *See Florida Key Deer v. Brown*, 364 F.Supp.2d 1345, 1356 (S.D. Fla. 2005) ("the record reveals that the 1997 RPAs illegally relied on voluntary measures . . . . [T]he Court finds that the 2003 RPAs, which merely re-adopt the 1997 RPAs … do not protect against jeopardy, and are therefore invalid under the APA."), a*ffirmed by Fla. Key Deer v. Paulison*, 522 F.3d 1133 (11th Cir. 2008); *Grand Canyon Trust v. United States Bureau of Reclamation*, 623 F. Supp. 2d 1015, 1037 (D. Ariz. 2009) ("The Ninth Circuit has explained that [c]onsulting with FWS alone does not satisfy an agency's duty under the Endangered Species Act. An agency cannot abrogate its responsibility to ensure that its actions will not jeopardize a listed species."); *Center for Biological Diversity v. United States Fish & Wildlife Serv.*, 450 F.3d 930, 941 (9th Cir. 2006) ("The recipient agency is immunized for incidental takings of endangered species as long as the agency complies with the reasonable and prudent measures specified by the Service for minimizing the action's impact on the endangered species.")

[234] 16 U.S.C. § 1538(a)(1)(B); 50 C.F.R. § 17.21(c)

[235] 16 U.S.C. § 1532(19); 50 C.F.R § 17.3

[236] 50 C.F.R. § 17.3

[237] 16 U.S.C. § 1536(o)(2); 50 C.F.R. § 402.14(i)(5)

[238] 16 U.S.C. § 1536(b)(4); 50 C.F.R. § 402.14(i)(1)(i)-(v)

Registration of pesticides is a federal action that can cause the take of listed species.[239] Consequently, EPA must have written authorization from FWS and/or NMFS in the form of an ITS when authorizing the sale and use, or permitting the ongoing sale and use of pesticides when those pesticides result in incidental take.

Mortality is the primary documented effect on wildlife from OP and carbamate pesticides.[240] As discussed above, these pesticides primarily affect the nervous system by inhibiting acetylcholinesterase enzyme activity. The respiratory muscles are the most critical muscle group affected, and respiratory paralysis is often the immediate cause of death.[241] Glaser identified the following pesticides for wildlife mortality incidents: carbofuran, methiocarb, oxamyl, aldicarb (all carbamates), chlorpyrifos, diazinon, dicrotophos, dimethoate, disulfoton, famphur, fenamiphos, fensulfothion, fenthion, fonofos, methamidophos, monocrotophos, parathion, phorate, and phosphamidon.[242] Other pesticides have also been attributed for die-offs of birds: acephate, azinphos-methyl, bendiocarb, brodifacoum, bromethalin, diclorvos, diphacinone, diuron, ethoprop, fenitrothion, heptachlor, imidacloprid, lindane, metalaxyl, methomyl, methyl parathion, metolachlor, mevinphos,oxydemeton-methyl, pendamethalin, pentachlophenol, phoxim, polybutane, propoxur, temephos, and terbufos.[243] Carbofuran, alone has been estimated to kill one to two million birds annually.[244]

EPA's registration of pesticides has resulted in take of listed species. As discussed above, several of the pesticides registered by the EPA are toxic to endangered species and have been found in the environment at acutely toxic and chronic levels. Although EPA has recognized that the use of pesticides results in mortality incidents, it has failed to complete consultation processes with FWS and/or NMFS in order to attain the necessary ITS for any take attributed to the use of the registered pesticides.

---

239 *Defenders of Wildlife*, 882 F.2d at 1300

240 Grue, C.E. et al. 1983. Assessing hazards of organophosphate pesticides to wildlife. Pages 200-220 *in* Transactions of the 48th North American Wildlife and Natural Resources Conference. The Wildlife Management Institute, Washington, D.C.

241 Glaser, L.C., Wildlife Mortality Attributed to Organophos-phorous and Carbamate Pesticides, National Biological Survey, USGS

242 *Id.*

243 *See* Wildlife Incident Data, compiled by Linda Lyon, Division of Refuges, US FWS, available at www.abcbirds.org/pesticides/IncidentData.htm

244 Cox, C. 1991. Pesticides and Birds: From DDT to Today's Poisons. *Journal of Pesticide Reform*, Vol.11, No.4 citing U.S. EPA, Office of Pesticides and Toxic Substances, 1989, Carbofuran: A special review technical support document, Washington, D.C.

### D. EPA is in Violation of the Migratory Bird Treaty Act by Registering Pesticides That Result in the Take of Migratory Birds

Section 703 of the Migratory Bird Treaty Act ("MBTA") prohibits the take of migratory birds, making it unlawful for anyone "at anytime, by any means or in any manner . . . to take . . . any migratory bird, [or] any part, nest, egg of any such bird."[245] Section 703 of the MBTA, which applies to federal agencies, includes poisoning of migratory birds from registered pesticides.[246]

EPA, through its reregistration of pesticides, has documented and acknowledged that pesticide use results in bird kills. The FWS has tracked bird kill incidents attributable to pesticide use and has provided such data to the EPA for its ecological assessments of these pesticides. EPA's wildlife mortality incident database has also tracked and attributed bird deaths to pesticide use. EPA has attributed over 1100 incidents of bird kills–many including hundreds of birds–attributed to pesticide use. Although the numbers of bird kills attributed to pesticides is alarming (thousands of bird deaths have resulted from the use of registered pesticides at allowed rates), it is only a fraction of the number of actual bird incidents attributable to pesticides.[247] For instance, in 2001, FWS attributed a 1998 bird kill incident near Lake Apopka to pesticides. FWS estimates that 672 million birds are directly exposed each year by pesticides on farms alone and that 10% of these, or roughly 67 million birds, die.[248] The Ecological Incident Information System ("EIIS") indicates that a few pesticides are associated with the majority of bird incidents. Carbofuran, a carbamate, and diazinon, an organophosphate, are associated with 55% of all avian incidents reported to EPA.[249] FWS notes that about 40 pesticides are known to kill birds even when applied according to prescribed application rates and methods.[250] EPA's registration of these pesticides, which have been documented as the cause for numerous bird deaths, is a violation of the MBTA.

## CONCLUSION

Sections 2(c) and 7(a)(1) of the ESA place affirmative conservation mandates on EPA to utilize its authorities in furtherance of the purposes of the ESA.[251] EPA's actions described above

---

[245] 16 U.S.C. § 703

[246] *See The Humane Society of the United States v. Glickman*, 217 F.3d 882 (D.C.Cir. 2000) and *United States v. Corbin Farm Service*, 444 F.Supp. 510 (E.D.Cal. 1978) *aff'd United States v. Corbin Farm Service*, 578 F.2d 259 (9th Cir. 1978)

[247] *See* Cox, C. 1991. Pesticides and Birds: From DDT to Today's Poisons. *Journal of Pesticide Reform*, Vol.11, No.4; *see also* Glaser, L.C., National Biological Service, Wildlife Mortality Attributed to Organophosphorous and Carbamate Pesticides

[248] FWS, Office of Migratory Bird Management, Pesticides and Birds, March 2000

[249] EIIS, March 1999; and Mastrota, F.N., 1999, Wildlife mortality incidents caused by pesticides

[250] FWS, Office of Migratory Bird Management, Pesticides and Birds, March 2000

[251] 16 U.S.C. §§ 1531(c)(1) & 1536(a)(1)

authorizing pesticide use violate these provisions as they do not further the conservation of listed species; in fact they do just the opposite, as they authorize activities that adversely affect individual listed species, degrade and pollute habitat, and undermine species survival.

Also, as discussed above, Section 7(a)(2) of the ESA requires each federal agency to 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 adverse modification of habitat of such species . . . determined . . . to be critical . . . ."[252] To accomplish this goal, EPA must consult with FWS or NMFS regarding pesticides that "may affect" a listed species.[253]

If EPA does not act within 60 days to correct the violations described in this letter, the Center will pursue litigation against EPA. If you have any questions, or would like to discuss, please contact us.

Sincerely,

Justin Augustine

______________________________

Justin Augustine
Center for Biological Diversity

Curt Bradley

______________________________

Curt Bradley
Center for Biological Diversity

[252] 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a)

[253] 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a)