

APPENDIX: Review of Pesticides

In order to ensure the Forest Service has access to the best available science regarding the risks posed by herbicides to wildlife, water, and ecosystems (as required by NEPA and Forest Planning regulations), we have reviewed essential information and summarized it here for a selection of commonly used herbicides.

2,4-D

2,4-D is a persistent, mobile herbicide used for control of broadleaf plants. It is a widespread water contaminant with monitoring data from the USGS, EPA, USDA, the California Department of Pesticide Regulation and the Washington Department of Agriculture finding traces of the pesticide in 37-59 percent of all surface water samples tested.¹ 2,4-D is highly prone to pesticide drift events due to its volatility and toxicity and has consistently been the most common pesticide involved in drift complaints.²

The labeled, aquatic use of 2,4-D can kill aquatic plants and invertebrates that endangered fish rely on for food and shelter, resulting in the U.S. National Marine Fisheries Service concluding that the use of 2,4-D was likely to jeopardize the continued existence of endangered Pacific salmon and steelhead species.³ In addition the EPA determined that nearly all current labeled uses of 2,4-D were likely to adversely affect endangered amphibians and reptiles like the endangered California Red-legged Frog and Alameda Whipsnake.⁴

In a 2016 evaluation, EPA found that 2,4-D can cause direct harm to all plants and animals if used according to the EPA-approved label.⁵ Harms found specifically for non-crop uses, like the ones proposed, are to ESA-listed vascular aquatic plants,⁶ chronic harm to all

¹ EPA. Preliminary Ecological Risk Assessment for Registration Review of 2,4-D at 24 (June 29, 2016), <https://www.regulations.gov/document?D=EPA-HQ-OPP-2012-0330-0047>.

² Association of American Pesticide Control Officials, 2005 Pesticide Drift Enforcement Survey Report (2005), https://www.centerforfoodsafety.org/files/aapco-2005_29712.pdf.

³ National Marine Fisheries Service Endangered Species Act Section 7 Consultation, Biological Opinion Environmental Protection Agency Registration of Pesticides 2,4-D, Triclopyr BEE, Diuron, Linuron, Captan, and Chlorothalonil (June 30, 2011), <https://www3.epa.gov/pesticides/endanger/litstatus/final-4th-biop.pdf>.

⁴ EPA, Risks of 2,4-D Use to the Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) and Alameda Whipsnake (*Masticophis lateralis euryxanthus*) (Feb. 20, 2009), <https://www3.epa.gov/pesticides/endanger/litstatus/effects/redleg-frog/2-4-d/analysis.pdf>.

⁵ *Id.*

⁶ *Id.* at 45-46.

species of birds that feed on short grasses,⁷ acute harm to all species of mammals,⁸ sublethal effects to pollinators such as bees,⁹ and all terrestrial plants.¹⁰ The potential for harm to non-target plants from spray drift extends up to 250 ft away from the site of application at an application rate of 2 lb/acre (the maximum application rate for non-crop uses is twice as high at 4 lb/acre).¹¹

There have been a high number of incidents involving human harm from 2,4-D. From 2007 to 2012, there were over 2,000 incidents reported to the EPA involving neurological, respiratory, liver, and kidney dysfunctions.¹² EPA also identified occupational exposure risks of concern via inhalation.¹³ The EPA also found that “Based on currently available toxicity data, which demonstrate effects on the thyroid and gonads following exposure to 2,4-D, there is concern regarding its endocrine disruption potential.”¹⁴ Altered hormone levels have also been associated with urinary 2,4-D levels in human epidemiological studies.¹⁵

Clethodim

Clethodim poses a risk to many non-target organisms, including freshwater fish and amphibians, for every single approved use of the pesticide.¹⁶ Mammals are also estimated to experience chronic harms from many uses of clethodim.¹⁷ Terrestrial plants, particularly monocots, are expected to experience reduced seedling emergence more than 1000 ft away from the treated area and experience growth impairment nearly 500 ft from the treated area.¹⁸

⁷ *Id.* at 47-48.

⁸ *Id.* at 48-49.

⁹ *Id.* at 50-51.

¹⁰ *Id.* at 51-55.

¹¹ *Id.* at 63.

¹² EPA, 2,4-D: Tier II Incident Report at 2-3 (June 28, 2016), <https://www.regulations.gov/document?D=EPA-HQ-OPP-2012-0330-0046>.

¹³ EPA, 2,4-D. Revised Occupational and Residential Exposure Assessment for Registration Review (Nov. 15, 2016), <https://www.regulations.gov/document?D=EPA-HQ-OPP-2012-0330-0085>.

¹⁴ EPA. *Reregistration Eligibility Decision for 2,4-D*. 2005; Available from: http://www.epa.gov/pesticides/reregistration/REDs/24d_red.pdf.

¹⁵ Garry, V.F., et al., Biomarker correlations of urinary 2,4-D levels in foresters: genomic instability and endocrine disruption. *Environ Health Perspect* (2001) 109(5) at p. 495-500; Schreinemachers, D.M., Perturbation of lipids and glucose metabolism associated with previous 2,4-D exposure: a cross-sectional study of NHANES III data, 1988-1994, *Env't. Health* (2010) 9 at 11.

¹⁶ EPA, Clethodim: Preliminary Ecological Risk Assessment for Registration Review, (January 13, 2014) at 51-52, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0658-0020>.

¹⁷ *Id.* at 59.

¹⁸ *Id.* at 61.

Clopyralid

EPA has found that some clopyralid uses can expose small and medium-sized mammals to levels of clopyralid that can decrease body weight and food consumption.¹⁹ Risks of concern were also identified for endangered herbivorous birds, reptiles and terrestrial amphibians, and terrestrial invertebrates, based on short-term exposures from the labelled uses of clopyralid.²⁰ The EPA found that clopyralid spray drift can result in harm to ESA-listed and non-ESA listed plants at a distance of more than 1,000 ft from where it is sprayed.²¹ When modelling the *lowest approved application rate*, EPA found that plants can be harmed more than 1000 feet away from aerial applications and nearly 500 feet away from ground applications.²²

Dicamba

Dicamba does not adsorb to soil and is highly mobile with the potential to contaminate and persist in groundwater.²³ It was one of the most frequently detected herbicides in water and sediment samples in California,²⁴ and 90 percent of air samples throughout Canada's agricultural region contained dicamba with distributions being suggestive of both local and long-distance transport.²⁵ Dicamba is characterized as a volatile compound and prone to extensive spray drift, which can severely impact non-target crops and wild plants.²⁶

Dicamba has caused an unprecedented amount of damage to crop fields, backyard gardens, century-old trees, and natural landscapes in recent years. It is estimated that nearly 5 million acres of crop fields were damaged by dicamba drift in 2017 and 2018 alone.²⁷ 200-year

¹⁹ EPA, Clopyralid: Draft Ecological Risk Assessment for Registration Review (Dec. 14, 2018) at 7, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2014-0167-0032>.

²⁰ *Id.* at 33, 39.

²¹ *Id.* at 41.

²² *Id.* at 42.

²³ EPA, Reregistration Eligibility Decision (RED) Document for Dicamba and Associated Salts (2006), http://www.epa.gov/pesticides/reregistration/REDs/dicamba_red.pdf.

²⁴ Ensminger, M.P., et al. Pesticide occurrence and aquatic benchmark exceedances in urban surface waters and sediments in three urban areas of California, USA, 2008-2011, *Environ Monit. Assess.* 185(5) (2013) at 3697-710.

²⁵ Yao, Y., et al. Spatial and temporal distribution of pesticide air concentrations in Canadian agricultural regions. *Atmospheric Environment* 40(23) (2006) at 4339-4351.

²⁶ Behrens, R. and W. Lueschen. Dicamba Volatility. *Weed Science* (1979) 27(5) at 486-493; Egan, J.F. and D.A. Mortensen, Quantifying vapor drift of dicamba herbicides applied to soybean, *Envt. Toxicol. Chem.* 31(5) (2012) at 1023-31.

²⁷ Bradley, K., Univ. of Missouri, A Final Report on Dicamba-injured Soybean Acres (Oct. 30, 2017), https://ipm.missouri.edu/ipcm/2017/10/final_report_dicamba_injured_soybean/; Bradley, K. July 15 Dicamba injury update: Different Year, same questions (July 19, 2018), <https://ipm.missouri.edu/IPCM/2018/7/July-15-Dicamba-injury-update-different-year-same-questions/>.

old cypress trees,²⁸ oak trees,²⁹ and fruiting trees³⁰ have not escaped the onslaught of damage from this pesticide. A federal USDA advisory committee has recommended that a buffer of no less than one mile be implemented between dicamba and any sensitive, non-target plant.³¹

Doses of dicamba meant to approximate herbicide drift reduced and delayed the flowering of multiple plant species, reducing the floral resources that pollinators rely on in farmed regions.³² Dicamba levels far below those estimated to be contained in particle and vapor drift are known to reduce plant diversity.³³ Similarly, drift-level rates of dicamba were found to reduce flowering of multiple plants, a reduction scientists have found coincides with reduced visitation by pollinators.³⁴ Studies have also shown dicamba to be particularly harmful to milkweed, a plant the monarch caterpillar uses as its only food source, putting the monarch butterfly at risk of harm.³⁵

EPA has determined that small birds and mammals would exceed the agency's level of concern for dicamba if they foraged on plants or insects in treated fields following treatment and that dicamba had the potential for causing risk to endangered birds, mammals, and non-target plants.³⁶ Furthermore, the EPA stated that "mammals could potentially be at risk for developmental/reproductive effects or for direct effects on foraging behavior when chronically

²⁸ Charles, D. A Drifting Weedkiller Puts Prized Trees at Risk, National Public Radio (September 27, 2018), <https://www.npr.org/sections/thesalt/2018/09/27/651262491/a-drifting-weedkiller-puts-prized-trees-at-risk>.

²⁹ Hettinger, J., Complaints surge about weed killer dicamba's damage to oak trees, Midwest Center for Investigative Reporting (October 9, 2017), <https://investigatmidwest.org/2017/10/09/complaints-surge-about-weed-killer-dicambas-damage-to-oak-trees/>.

³⁰ Ruff, C., Jury Awards Missouri Peach Farmer \$15 Million In Damages in Dicamba Suit, St. Louis Public Radio (February 14, 2020) <https://news.stlpublicradio.org/post/jury-awards-missouri-peach-farmer-15-million-damages-dicamba-suit#stream/0>.

³¹ Fruit and Vegetable Industry Advisory Committee (FVIAC), 2018 – 2020 Recommendations, https://www.ams.usda.gov/sites/default/files/media/2018_2020FVIACRecommendations.pdf.

³² Bohnenblust, E.W., et al., Effects of the herbicide dicamba on non-target plants and pollinator visitation, *Env. Toxicol Chem.* (2015).

³³ Egan, J.F, Bohnenblust, E, Goslee, S, Mortensen, D.A, and Tooker, J., Herbicide drift can affect plant and arthropod communities, *Agric., Ecosystems, and Env.* 185 (2014) at 77-87.

³⁴ Bohnenblust, E.W, Vaudo, A.D, Egan, J.F, Mortensen, D.A, Tooker, J.F. Effects of the herbicide dicamba on nontarget plants and pollinator visitation. *Environ Toxicol Chem.* 35(1) (2016) at 144–151

³⁵ Donley, N., A Menace to Monarchs Drift-prone Dicamba Poses a Dangerous New Threat to Monarch Butterflies, Center for Biological Diversity (March 2018), https://www.biologicaldiversity.org/species/invertebrates/monarch_butterfly/pdfs/Menace-to-Monarchs.pdf.

³⁶ EPA, Reregistration Eligibility Decision (RED) Document for Dicamba and Associated Salts (2006) http://www.epa.gov/pesticides/reregistration/REDs/dicamba_red.pdf.

exposed to dicamba as a result of the labeled uses of the herbicide.”³⁷ Dicamba has also been shown to disrupt behavioral patterns in fish³⁸ and low doses were shown to induce mortality in coho salmon that were given a biologically-appropriate seawater challenge.³⁹

There are early indications that dicamba may affect hormone signaling⁴⁰ and induce developmental toxicities⁴¹ at biologically-relevant doses. Multiple studies have also indicated that it is a mutagen.⁴²

Endothall

The EPA has identified many harms to non-target organisms from the labelled uses of endothall. Acute harm to mammals was identified from all terrestrial uses of endothall and reproductive harm, resulting in decreased birth weight of pups and pup death, was also identified for a subset of uses.⁴³ Some uses of endothall were found to expose birds that feed on grasses, broad leaf plants, and small insects to nine times the amount known to cause early embryonic mortality.⁴⁴ As with many herbicides, endothall was also found to result in harm to non-target plants.

³⁷ *Id.*

³⁸ Ruiz de Arcaute, C., S. Soloneski, and M.L. Larramendy, Evaluation of the genotoxicity of a herbicide formulation containing 3,6-dichloro-2-methoxybenzoic acid (dicamba) in circulating blood cells of the tropical fish *Cnesterodon decemmaculatus*, *Mutat. Res. Genet. Toxicol. Evt. Mutagen* 773 (2014) at 1-8.

³⁹ Lorz, H., et al., EPA, Corvallis Environmental Research Laboratory Office of Research and Development, Effects of selected herbicides on smolting of coho salmon (1979).

⁴⁰ Zhu, L., et al., Dicamba affects sex steroid hormone level and mRNA expression of related genes in adult rare minnow (*Gobiocypris rarus*) at environmentally relevant concentrations, *Evt. Toxicol* 30(6) (2015) at 693-703; Goldner, W.S., et al. Hypothyroidism and pesticide use among male private pesticide applicators in the agricultural health study, *J. Occup Evt. Med.*, 55(10) (2013) 1171-8.

⁴¹ Greenlee, A.R., T.M. Ellis, and R.L. Berg, Low-dose agrochemicals and lawn-care pesticides induce developmental toxicity in murine preimplantation embryos, *Evt. Health Perspectives* 112(6) (2004) 703-9.

⁴² Ruiz de Arcaute, C., S. Soloneski, and M.L. Larramendy, Evaluation of the genotoxicity of a herbicide formulation containing 3,6-dichloro-2-methoxybenzoic acid (dicamba) in circulating blood cells of the tropical fish *Cnesterodon decemmaculatus*, *Mutat. Res. Genet. Toxicol. Evt. Mutagen* 773 (2014) at 1-8; Cenkci, S., et al., Evaluation of 2,4-D and Dicamba genotoxicity in bean seedlings using comet and RAPD assays, *Ecotoxicol. Evt. Safety* 73(7) (2010) at 1558-64; Gonzalez, N.V., et al., A combination of the cytokinesis-block micronucleus cytome assay and centromeric identification for evaluation of the genotoxicity of dicamba, *Toxicol. Lett.* 207(3) (2011) at 204-12.

⁴³ EPA, Reregistration Eligibility Decision for Endothall (Sept. 2005) at 18, https://archive.epa.gov/pesticides/reregistration/web/pdf/endothall_red.pdf.

⁴⁴ *Id.*

Endothall is considered “highly toxic” to “very highly toxic” to freshwater fish and invertebrates by the EPA.⁴⁵ EPA has concluded that all uses including direct water application and terrestrial application resulted in risks of concern to fish and aquatic invertebrates.⁴⁶

Fluazifop-P-Butyl

Using fluazifop according to the pesticide label can expose mammals to concentrations that are known to cause reduced pup viability and pup weight.⁴⁷ Fluazifop can also cause chronic harm to bee larva following every use of the pesticide that was modelled by EPA.⁴⁸ Terrestrial plants can be exposed to levels of fluazifop via spray drift that can cause harm, anywhere from 100 to 1,000 ft from the treated area.⁴⁹

Glyphosate

A 2015 EPA analysis found multiple environmental harms from glyphosate use. Use of glyphosate in accordance with the label was found to:

- 1) Result in concentrations that can potentially impact the survival and biomass of aquatic plants, upland plants, and riparian/wetland plants.⁵⁰
- 2) Result in residues on foliage that can potentially impact the growth of herbivorous birds, reptiles and terrestrial amphibians.⁵¹
- 3) Potentially impact the growth and reproduction of terrestrial mammals following ground applications of glyphosate.⁵²

This analysis also indicated that considerable no-spray buffers would be needed to keep off-target plants from being harmed by glyphosate use, more than 1000 feet for certain aerial applications and nearly 400 feet for certain ground applications.⁵³

Ecological incident data also reinforce the finding that the current labelled uses of glyphosate are having devastating effects to plant and animal life outside of the sprayed field.⁵⁴

⁴⁵ *Id.* at 19.

⁴⁶ *Id.* at 19-20.

⁴⁷ EPA, Fluazifop-p-butyl: Draft Ecological Risk Assessment for Registration Review (June 27, 2019) at 61, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2014-0779-0017>.

⁴⁸ *Id.* at 64-65.

⁴⁹ *Id.* at 67.

⁵⁰ EPA, Preliminary Ecological Risk Assessment for Glyphosate and Its Salts (Sept. 8, 2015) at 2, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2009-0361-0077>.

⁵¹ *Id.*

⁵² *Id.*

⁵³ *Id.* at 92.

⁵⁴ *Id.* At 59-62.

Approximately 600 incidents have been reported and logged on the Ecological Incident Information System (EIIS) and Avian Monitoring Information System (AIMS) databases. A separate Incident Data System (IDS) database has identified 269 separate aggregate incident reports. Ecological incidents are also significantly underreported for pesticides so this should be viewed as the absolute bare minimum of ecological incidents that involve glyphosate.

A recent draft biological evaluation was recently conducted by the EPA on how use of glyphosate may affect all endangered and threatened species in the United States. The agency concluded that glyphosate would “Likely Adversely Affect” 1676 out of 1795 listed species (93%) and adversely modify 759 out of 792 designated critical habitat in the U.S.⁵⁵ This includes nearly every single listed species and critical habitat in the United States and all that reside in or near the action area being considered.⁵⁶

Some glyphosate formulations and co-formulants have been found to be “highly toxic” to certain species of fish.⁵⁷

Researchers have found negative associations between glyphosate use and monarch population size.⁵⁸ Use of glyphosate has been tied to widespread declines of milkweed, which is essential to monarch butterfly survival.⁵⁹

The World Health Organization’s International Agency for Research on Cancer (“IARC”) conducted an exhaustive review of the publicly available scientific literature in 2015

⁵⁵ EPA, Draft National Level Listed Species Biological Evaluation for Glyphosate, Exec. Summary (Nov. 2020) <https://www.epa.gov/endangered-species/draft-national-level-listed-species-biological-evaluation-glyphosate>.

⁵⁶ *Id.* at Appendix 4-1

⁵⁷ *Id.* at 82, 84.

⁵⁸ Semmens, B. X., D. J. Semmens, W. E. Thogmartin, R. Wiederholt, L. Lopez-Hoffman, J. E. Diffendorfer, J. M. Pleasants, K. S. Oberhauser and O. R. Taylor, Quasi-extinction risk and population targets for the Eastern, migratory population of monarch butterflies (*Danaus plexippus*), *Sci. Rep.* 6 (2016) 23265.

⁵⁹ Center for Biological Diversity, Petition to Protect the Monarch Butterfly (*Danaus Plexippus Plexippus*) Under the Endangered Species Act, 7 (2014), http://www.biologicaldiversity.org/species/invertebrates/pdfs/Monarch_ESA_Petition.pdf (“A primary threat to the monarch is the drastic loss of milkweed caused by increased and later season use of the herbicide glyphosate in conjunction with widespread planting of genetically engineered, herbicide-resistant corn and soybeans in the Corn Belt region of the United States and to planting of genetically-engineered cotton in California. In the Midwest, nearly ubiquitous adoption of, glyphosate-resistant ‘Roundup Ready’ corn and soybeans has caused a precipitous decline of common milkweed, and thus of monarchs, which lay their eggs only on milkweeds. The majority of the world’s monarchs originate in the Corn Belt region of the United States where milkweed loss has been severe, and the threat that this habitat loss poses to the resiliency, redundancy, and representation of the monarch cannot be overstated.”).

and concluded that glyphosate is “probably carcinogenic to humans” (Group 2A).⁶⁰ IARC carefully weighed evidence in three areas, and found that: 1) There was sufficient evidence to conclude that glyphosate causes cancer in animal studies; 2) There was limited evidence that exposure to glyphosate causes cancer (non-Hodgkin lymphoma) in humans; and 3) There was strong evidence that glyphosate can damage DNA and induce oxidative stress, two well characterized pathways that can lead to cancer.⁶¹

IARC’s finding that glyphosate causes cancer in animals prompted California’s Office of Environmental Health Hazard Assessment to list glyphosate as a known carcinogen under California’s Proposition 65 law.⁶² The agency has also finalized a No Significant Risk Level for glyphosate, which estimated the daily exposure level that will result in a 1/100,000 chance of developing cancer, of 1.1 mg/day.⁶³

Picloram

Picloram is highly persistent, with a half-life that can range from one month to 116 years.⁶⁴ It is one of the most mobile pesticides still used in the U.S. and a known water contaminant that has been detected in water systems in 43 different states.⁶⁵ EPA found that 136 water systems servicing more than 8 million people across the country had detections of picloram above the health safety threshold.⁶⁶

⁶⁰ WHO, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 112: Some Organophosphate Insecticides and Herbicides, Glyphosate (2017) at 78, <http://monographs.iarc.fr/ENG/Monographs/vol112/mono112.pdf>

⁶¹ *Id.* at 78-79.

⁶² California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Glyphosate Listed Effective July 7, 2017, as Known to the State of California to Cause Cancer, <https://oehha.ca.gov/proposition-65/cnr/glyphosate-listed-effective-july-7-2017-known-state-california-cause-cancer>.

⁶³ California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Amendment to Section 25705 No Significant Risk Level - Glyphosate (April 10, 2018) <https://oehha.ca.gov/proposition-65/cnr/amendment-section-25705-no-significant-risk-level-glyphosate-april-10-2018>.

⁶⁴ California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Public Health Goals: Carbofuran, Diquat, Endrin, Picloram, Thiobencarb in Drinking Water (Sept. 2016), <https://oehha.ca.gov/media/downloads/water/chemicals/phg/pesticidebatch092316.pdf>.

⁶⁵ EPA, R.E.D. FACTS Picloram (Aug.1995), https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_PC-005101_1-Aug-95.pdf; EPA, The Analysis of Regulated Contaminant Occurrence Data from Public Water Systems in Support of the Second Six-Year Review of National Primary Drinking Water Regulations (Sept. 2010), <https://www.epa.gov/sites/production/files/2014-12/documents/815b09006.pdf>.

⁶⁶ *Id.*

EPA also found that picloram has a “very high potential” to leach into groundwater, and that once it reaches groundwater will be unlikely to degrade for multiple years.⁶⁷

Eventual contamination of ground water is virtually certain in areas where picloram residues persist in the overlying soil. Once in ground water, picloram is unlikely to degrade, even over a period of several years.⁶⁸

In 1998-99, USGS found that 10% of groundwater testing sites had detections of picloram in Wyoming and that picloram was detected at the highest concentration of any other pesticide tested.⁶⁹

Picloram’s main effect to humans is liver toxicity. Picloram acid is also designated highly toxic through inhalation exposure, meaning it has a high potential to cause harm to humans through the airway.⁷⁰

Picloram is a restricted use pesticide based on its extreme toxicity to non-target plants. EPA found that estimated concentrations from the labelled use of picloram are hundreds to thousands of times the amount known to cause harm to non-target plants.⁷¹ A recent EPA risk assessment found that the labelled use of picloram exceed the agency’s risk levels of concern to terrestrial dicot plants by as much as 1,200-fold.⁷² Even when particle drift was modelled under potential restriction scenarios, harm to non-target plants still occurred over 1,000 feet from the use site from ground application alone.⁷³

Sethoxydim

Sethoxydim is highly water soluble and has very low soil adsorption, so it is highly likely to run-off and seep into groundwater.⁷⁴ Sensitive aquatic and terrestrial species that rely on wetlands or cave systems fed by ground or surface water are at most risk from ground water pollution of sethoxydim from nearby usage areas.

⁶⁷ EPA, R.E.D. FACTS: Picloram (Aug. 1995), https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_PC-005101_1-Aug-95.pdf.

⁶⁸ *Id.* at 5.

⁶⁹ United States Geological Survey, Wyoming Department of Agriculture and Wyoming Department of Environmental Quality, Pesticides in Ground Water - Fremont County, Wyoming, 1998-99 (March 2000), <https://pubs.usgs.gov/fs/fs03500/fs03500.pdf>.

⁷⁰ EPA, R.E.D. FACTS Picloram (Aug. 1995), https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_PC-005101_1-Aug-95.pdf.

⁷¹ *Id.* at 6.

⁷² EPA, Picloram: Draft Ecological Risk Assessment for Registration Review (March 27, 2020) at 56, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2013-0740-0055>.

⁷³ *Id.* at 58.

⁷⁴ EPA, Sethoxydim: Draft Ecological Risk Assessment for Registration Review (Aug. 16, 2019) at 19–20, <https://www.regulations.gov/document/EPA-HQ-OPP-2015-0088-0019>.

When used according to label directions, sethoxydim presents a risk to non-target terrestrial and aquatic plants from exposure in drift and runoff, with negative effects to terrestrial plants occurring as far as 548 ft and 144 ft from the treated area for aerial and ground applications, respectively.⁷⁵ EPA's 2019 ecological risk assessment found that sethoxydim can have sublethal effects to mammals that feed on plants and insects sprayed with the pesticide.⁷⁶ Sethoxydim can also impact the feeding and growth of terrestrial invertebrates like bees as far as 69 ft and 10 ft away from the treated area with aerial and ground applications, respectively.⁷⁷ Data gaps remain in EPA's risk assessment for sethoxydim, as there are no data for larval chronic toxicity to bees nor any toxicity data for terrestrial invertebrates other than honey bees. Despite its low overall usage sethoxydim has been detected in a national survey of honey bee pollen.⁷⁸

Endangered butterflies are potentially at risk from sethoxydim used for habitat conservation if application is poorly timed or overused. Sethoxydim residues on larval food plants have been shown to reduce cabbage white butterfly survival, reduce development time for the Puget blue butterfly,⁷⁹ reduce survival in *Euphydryas* butterfly larvae,⁸⁰ and reduce the number of Behr's metalmark butterfly pupae and the survival rate of adults.⁸¹ Restricting the timing of sethoxydim applications to the diapause period when butterflies are not active can protect sensitive life states of butterflies of conservation concern.⁸²

Triclopyr

EPA has found that the range, pastureland, and rights-of-way uses of triclopyr can expose birds, reptiles and terrestrial amphibians to levels of the herbicide that cause reduced survival of offspring.⁸³ The same uses can expose mammals to 37 times the amount of triclopyr known to reduce litter size.⁸⁴ All labelled uses of triclopyr were found to expose adult and larval bees to

⁷⁵ *Id.* at 48

⁷⁶ *Id.* at Table 9-4.

⁷⁷ *Id.* at 45-46.

⁷⁸ Nancy Ostiguy et al., Honey Bee Exposure to Pesticides: A Four-Year Nationwide Study, *Insects* 10, no. 1 (January 2019), <https://doi.org/10.3390/insects10010013>.

⁷⁹ Cheryl Russell and Cheryl B. Schultz, Effects of Grass-Specific Herbicides on Butterflies: An Experimental Investigation to Advance Conservation Efforts, *J. of Insect Conservation* 14, no. 1 (Feb. 1, 2010) at 57–58, <https://doi.org/10.1007/s10841-009-9224-3>.

⁸⁰ Cheryl B. Schultz et al., Non-Target Effects of Grass-Specific Herbicides Differ among Species, Chemicals and Host Plants in *Euphydryas* Butterflies, *J. of Insect Conservation* 20, no. 5 (Oct. 2016) at 5, <https://doi.org/10.1007/s10841-016-9920-8>.

⁸¹ John D. Stark, Xue Dong Chen, and Catherine S. Johnson, Effects of Herbicides on Behr's Metalmark Butterfly, a Surrogate Species for the Endangered Butterfly, Lange's Metalmark, *Envt. Pollution (Barking, Essex: 1987)* 164 (May 2012) at 26, <https://doi.org/10.1016/j.envpol.2012.01.011>.

⁸² Russell and Schultz, Effects of Grass-Specific Herbicides on Butterflies at 60–61.

⁸³ EPA, Triclopyr (Acid, Choline salt, TEA salt, BEE): Draft Ecological Risk Assessment for Registration Review (Sept. 30, 2029) at 6, <https://www.regulations.gov/document?D=EPA-HQ-OPP-2014-0576-0026>.

⁸⁴ *Id.* at 8.

levels estimated to reduce survival and larval emergence.⁸⁵ Harm to bee larva was estimated more than 1000 feet from the application site.⁸⁶ Terrestrial plants were also estimated to be exposed to levels of triclopyr that were known to cause harm more than 1000 feet away from the site of application, even for ground applications.⁸⁷

Triclopyr butoxyethyl ester (BEE) is classified as “highly toxic” to aquatic organisms. Range, pastureland and meadow uses of BEE can expose fish and aquatic invertebrates to levels of the pesticide known to cause acute harm.⁸⁸ The EPA has found that triclopyr poses a risk to a federally listed amphibian, the California Red-legged frog, making a Likely to Adversely Affect determination for the species.⁸⁹

⁸⁵ *Id.* at 9.

⁸⁶ *Id.* at 90.

⁸⁷ *Id.* at 94-95.

⁸⁸ *Id.* at 9.

⁸⁹ EPA, Risks of Triclopyr Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) Pesticide Effects Determination (Oct. 19, 2009), <https://www3.epa.gov/pesticides/endanger/litstatus/effects/redleg-frog/triclopyr/analysis.pdf>.