**Simazine Executive Summary for Draft Biological Evaluation**

This Biological Evaluation (BE) assesses potential risks that registered uses of simazine (PC code 080807) may pose to an individual of a listed species or designated critical habitat. The federal action considered

in this BE is the Registration Review for simazine, which encompasses the review of all the registered uses and any agreed upon changes to these labels from the technical registrants, and the approved product labels for all pesticide products containing simazine.

The term “listed species” includes those that are federally listed as endangered and threatened, as well as those that are proposed and candidates for listing and experimental populations. The methods employed in this BE follow the Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides (referred to as the “Revised Method”)[[1]](#footnote-2). The Revised Method incorporates comments from the public, US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS) and US Department of Agriculture (USDA).

As described in the Revised Method, EPA’s development of this BE includes two steps. The BE includes an evaluation of whether an individual of a listed species is reasonably expected to be exposed to a pesticide at a level that results in a discernable effect, and, if so, distinguishes effects that are likely to adversely affect an individual of a species from those that are not likely to adversely affect an individual. This process is also applied to the designated critical habitat of listed species (when available). In Step 1, for every listed species and designated critical habitat, EPA determines whether simazine will have No Effect (NE) or May Affect (MA) (separate determinations made for each species and critical habitat). For those species and critical habitats with MA determinations, in Step 2, EPA will determine if simazine is Not Likely to Adversely Affect (NLAA) or Likely to Adversely Affect (LAA) each individual species or critical habitat. Details on the method, models and tools used for making NE, NLAA and LAA determinations are provided in the Revised Method document.

# General Information

Simazine is one of the most widely used herbicides in North America. It is a chlorotriazine herbicide registered in the U.S. to control annual broadleaf and grass weeds. Simazine is used on several crops (orchard crops and vegetable crops), Christmas tree plantations and turf. Between 2013 and 2017, the annual total agricultural usage averaged approximately 2.9 million pounds of simazine active ingredient (a.i.), whereas the average total treated acreage was 2.5 million. During this time frame, the crops with the most usage in terms of annual average total pounds of active ingredient applied were corn (2,300,000 lbs), oranges (200,000 lbs), and wine grapes (80,0000 lbs). Most recent non-agricultural usage data from 2013 – 2017 shows that the largest use in terms of average annual pounds applied is for ornamentals that includes Christmas tree plantings (400,000 lbs.) and golf courses (200,000 lbs) (**APPENDIX 1-4**).

This BE assesses all currently registered labels and any agreed upon changes to these labels from the registrants. While the current labels may not reflect all the agreed upon changes, the technical registrants have agreed in the form of commitment letters (see **APPENDIX 1-2**) to update the simazine formulated product labels to be reflective of the changes (uses summarized in **APPENDIX 1-3**). Major changes in the commitment letters include restriction of applications to the contiguous United States only, removal of certain uses, and implementation of new buffers and mandatory spray drift language (see **APPENDIX** **1-2** for specific details). Simazine may be applied by ground broadcast, band application, chemigation, or spot treatment. Simazine has many preemergence uses in corn (see **APPENDIX 1-2**).

The main routes of dissipation for simazine are microbial degradation under aerobic conditions, runoff, and leaching. Simazine’s primary transport routes from treated areas to aquatic habitats include spray drift and runoff. Because of its persistence and mobility, simazine can move into surface and ground water. Simazine has a low vapor pressure and Henry’s Law Constant, suggesting low potential for volatilization. Simazine is moderately soluble in water with reported aqueous solubility values ranging from 3.5 to 11 mg/L at 20-25oC. Bioaccumulation of simazine is expected to be low due to a low octanol water partitioning coefficient (Kow = 122) and low bioconcentration factors (BCF). Soil sorption coefficients for simazine (KF) range from 0.5 to 4.3 ml/g (1/n=0.79-1.40) (MRID 41442903). Information on leaching and adsorption/desorption indicate that simazine is considered moderately mobile according to the Food and Agricultural Organization (FAO) mobility classification system[[2]](#footnote-3). Additional details on the fate of simazine are provided in **Chapter 3** of the Biological Evaluation. Residues of concern are discussed in **APPENDIX 1-8**.

Similar to the other chlorotriazine herbicides with current registrations in the United States (simazine, atrazine and propazine), simazine works by binding with a protein complex of the photosystem II in chloroplast photosynthetic membranes (Schulz et al., 1990). The result is an inhibition in the transfer of electrons through the light reactions of photosynthesis that in turn inhibits the formation and release of oxygen, production of adenosine triphosphate, and the fixation of carbon dioxide into sugars. Plant death results from starvation and oxidative damage caused by the breakdown in photosynthesis. The three chlorotriazines result in similar herbicidal effects to terrestrial and aquatic plants.

Simazine is slightly toxic to birds and mammals and is practically non-toxic to terrestrial invertebrates on an acute exposure basis. In most terrestrial animal species, sublethal effects are the predominant concern and are discussed further below. On an acute exposure basis, simazine is moderately toxic to freshwater and estuarine/marine fish and estuarine/marine invertebrates, and highly toxic to freshwater aquatic invertebrates. In both terrestrial and aquatic animals, simazine demonstrates a variety of growth and reproductive effects at a range of chronic exposure concentrations. Simazine has demonstrated adverse effects on growth to both vascular and non-vascular aquatic plants as well as terrestrial plants. There are reported ecological incidents involving simazine use for birds, mammals, fish, terrestrial invertebrates, and terrestrial plants. More details on the available toxicity data and incident reports are provided in **Chapter 2**.

# Exposure Methods

Exposure estimates are based primarily on fate and transport model results. Aquatic exposures (surface water and benthic sediment pore water) are quantitatively estimated for representative simazine uses in specific geographic regions within generic habitats (referred to as bins) using the Pesticide Root Zone Model (PRZM5) and the Variable Volume Water Model (VVWM)[[3]](#footnote-4) in the Pesticides in Water Calculator (PWC). Aquatic exposure results for the bin(s) most appropriate for the species and/or critical habitat are discussed in **Chapter 3**. Also discussed in **Chapter 3** are available water monitoring data for simazine. For terrestrial exposures, existing models [*i.e.*, AgDRIFT, earthworm fugacity model, Terrestrial Herpetofaunal Exposure Residue Program Simulation (T-HERPS), Terrestrial Residue Exposure model (T-REX) and portions of the Terrestrial Investigation Model (TIM)] were combined and modified into a single tool that is referred to as the MAGTool (**Chapter 4**). This assessment replaces EPA’s TerrPlant model with the Plant Assessment Tool (PAT), the latter is a more refined exposure model for terrestrial, wetland and aquatic plants.

# Overlap Analyses

Step 1 of the BE involves an analysis of the potential overlap of the action area and individual species ranges and critical habitat. The action area was derived in ArcGIS 10.7 by combining the data layers representative of simazine uses and then buffering them out to the off-site transport distance estimated using the AgDRIFT model (**APPENDIX 1-6**). The overlaps of action area and individual species’ ranges or critical habitats were calculated. This analysis used spatial data of species’ ranges and critical habitats from the FWS and NMFS. In the contiguous United States (ConUS), agricultural potential use sites are represented using the USDA Crop Data Layer (CDL) (**APPENDIX 1-5**). Because the technical registrants of simazine have committed to limit use of simazine products to ConUS, spatial layers of use sites in AK, HI and the territories are not needed. All species or critical habitats with some overlap of the action area and their range or designated critical habitat, or with some overlap on species that the listed species depends on (**Chapter 4**) are assessed in the MAGTool to make LAA/NLAA determinations.

# Effects Determinations

This BE makes effects determinations (NE, NLAA or LAA) for 1795 listed species, and 792 designated critical habitats. For each species and designated critical habitat, the effects determination is based on the methodology detailed in Chapter 1 and the Revised Method document[[4]](#footnote-5). NE determinations were made for 680 species and 424 critical habitats because there was no overlap between the species range/critical habitat and the action area. Many of the NE determinations were made for species that only inhabit areas outside of ConUS (*e.g.*, Hawaii). These NE determinations were based on the exclusion of states and US territories outside of the ConUS based on commitment letters provided by the technical registrant (**APPENDIX 1-2**). MA determinations were made for 1115 species and 368 critical habitats. All species and critical habitats with a MA determination progressed to the Step 2 analysis where an NLAA or LAA determination is made. NLAA determinations were made for 122 species and 52 critical habitats. LAA determinations were made for 993 species and 316 critical habitats. Specific species determinations are provided in **APPENDIX 4-1.**

The MAGTool estimates the number of individuals of a listed species that are potentially affected, incorporating the degree of overlap of a species range with potential use sites and associated usage data for a chemical (and associated off-site transport areas) into the effects determinations. Using the toxicity endpoints for each taxon (**Chapter 2**), the MAGTool utilizes probabilistic methods to assess the impact of various assumptions of toxicity and exposure on the likelihood that atrazine will adversely affect an individual of a given species. To help determine the potential for risk, the MAGtool incorporates many of EPA’s standard pesticide exposure models to estimate exposures to listed species and their prey, pollination, habitat and dispersal vectors (PPHD). Details on the individual effects determinations are found in **APPENDIX 4-1**. If the model estimates are not considered representative of the exposure of the species (due to an inconsistency in the exposure model and assessed species’ habitat), a qualitative analysis is conducted. In those cases, EPA makes either a LAA or a NLAA determination based on a qualitative weight of evidence. For each LAA determination, this assessment employs three categories (*i.e.,* strongest, moderate and weakest) to characterize the strength of the weight of evidence. Each species or critical habitat was assigned a weak, moderate or strong evidence in the LAA determination based on multiple factors, including: the impact of using less conservative assumptions in the analysis, the quality of the species range or usage data, impacts to both the species and prey, pollination, habitat, and dispersal (PPHD) as opposed to only one, the presence of reported incidents involving the species taxa or PPHD taxa, the presence of monitoring data that exceeds endpoints, exposure only due to spray drift and the likelihood of drift into a species habitat (e.g., if the species inhabits forests).

Of the LAA determinations, the majority (80% of species and 74% of critical habitats) were considered to have moderate evidence. Strongest evidence was found for 9% of species and 14% of critical habitat LAA determinations. Weakest evidence was found for 10% of species and 12% of critical habitat LAA determinations. Developed, Open Space Developed and Corn UDLs, were the use sites most frequently associated with impacts to species or critical habitats with LAA determinations. LAA determinations were made for species across all taxa.For certain species and critical habitats, there were uncertainties in the simazine effects determinations based on the resolution of spatial data, resolution of usage data, and the threshold for assessing impacts on PPHD (detailed in **Chapter 4**).Tables 1 and 2 summarize the NE, NLAA and LAA determinations for species and critical habitats. Table 3 summarizes the strength of evidence classifications for the LAA determinations.

**Table 1. Summary of Species Effects Determinations for Simazine (Counts by Taxon).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | **Step 2 Effects Determinations** | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 14 | 85 | 21 | 64 | 99 |
| Birds | 58 | 50 | 10 | 40 | 108 |
| Amphibians | 4 | 32 | 1 | 31 | 36 |
| Reptiles | 10 | 37 | 11 | 26 | 47 |
| Fish | 0 | 190 | 18 | 172 | 190 |
| Plants | 498 | 450 | 25 | 425 | 948 |
| Aquatic Invertebrates | 10 | 197 | 17 | 180 | 207 |
| Terrestrial Invertebrates | 86 | 74 | 19 | 55 | 160 |
| Total | 680 | 1115 | 122 | 993 | 1795 |
| Percent of total | 38% | 62% | 7% | 55% |   |

**Table 2. Summary of Critical Habitat Effects Determinations for Simazine (Counts by Taxon).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | **Step 2 Effects Determinations** | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 6 | 27 | 8 | 19 | 33 |
| Birds | 14 | 17 | 1 | 16 | 31 |
| Amphibians | 3 | 22 | 2 | 20 | 25 |
| Reptiles | 8 | 8 | 2 | 6 | 16 |
| Fish | 4 | 103 | 12 | 91 | 107 |
| Plants | 365 | 95 | 7 | 88 | 460 |
| Aquatic Invertebrates | 4 | 67 | 10 | 57 | 71 |
| Terrestrial Invertebrates | 20 | 29 | 10 | 19 | 49 |
| Total | 424 | 368 | 52 | 316 | 792 |
| Percent of total | 54% | 46% | 7% | 40% |   |

**Table 3. Classification of LAA Determinations by Strength of Evidence.**

|  |  |  |
| --- | --- | --- |
| **Strength of LAA call** | **Species range** | **Critical Habitat** |
| **Number** | **% of LAA determinations** | **Number** | **% of LAA determinations** |
| Strongest evidence of LAA | 91 | 9% | 43 | 14% |
| Moderate evidence of LAA | 798 | 80% | 234 | 74% |
| Weakest evidence of LAA | 104 | 10% | 39 | 12% |

1. Available at: <https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional> [↑](#footnote-ref-2)
2. The FAO mobility classification system is recommended for use in exposure assessments in the Office of Pesticide Programs in “*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in the Problem Formulation for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*” (USEPA, 2010). [↑](#footnote-ref-3)
3. The exposure models can be found at: <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment> [↑](#footnote-ref-4)
4. Available at: <https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional> [↑](#footnote-ref-5)