**Simazine Executive Summary for Biological Evaluation**

A biological evaluation (BE) is a generic term for an analysis that a federal agency conducts when it takes action subject to review under the Endangered Species Act (ESA). EPA prepares a BE to evaluate the potential effects of an agency action (here registered uses of simazine (PC code 080807) on listed and proposed species and designated and proposed critical habitat). This BE encompasses the review of all the registered uses and the approved product labels for all pesticide products containing simazine as well as any agreed upon changes to these labels from the registrants.

Under its current approach for registration review for conventional pesticides, EPA meets its ESA obligations through a three-step process. EPA’s development of this BE includes two steps. In Step 1, for each listed species and each designated critical habitat, EPA evaluates whether the registered uses of simazine will have No Effect (NE) or if the registered uses May Affect (MA) an individual of such species or habitat (separate determinations made for each species and critical habitat). More specifically, Step 1 is intended to be a conservative screen that is heavily reliant upon overlap of (1) areas where an environmentally discernable effect could occur from any labeled use of the pesticide being assessed (assumes the pesticide could be used in all areas allowable on the label) with (2) areas where species range/designated critical habitat occurs. It uses conservative assumptions and is intended to screen out species that are not reasonably expected to be exposed to the pesticide because they are outside of the pesticide use area, or when no environmentally discernable effect is expected to occur. If EPA determines there is no effect, that is the end of the analysis for that particular species.

In Step 2, for those species and critical habitats that EPA determines an individual may be affected, EPA uses additional information to determine if simazine may affect but is Not Likely to Adversely Affect (NLAA) or may affect and is Likely to Adversely Affect (LAA) an individual of a species or its critical habitat. Step 2 uses a more refined spatial overlap with specific pesticide use sites to calculate the portion of the population exposed, considers life history information, considers actual pesticide applications (usage data), additional toxicity data, and a range of potential exposure concentrations. If EPA makes a NLAA determination, then EPA must informally consult with the Services to seek concurrence on the determination. Otherwise, if EPA makes a LAA determination, EPA must engage in formal consultation with the Services. Details on the method, models and tools used for making NE, NLAA and LAA determinations are provided in the Revised Method document.[[1]](#footnote-2)

Practically, the LAA threshold for a BE is very conservative as the likely predicted “take” of even one individual of a species triggers an LAA determination (even if that species is almost recovered). This often results in a high number of MA and LAA determinations in a BE. An LAA determination in the BE, however, should not be interpreted to suggest that EPA has made a determination that simazine is putting a species in jeopardy or adversely modifying its critical habitat. Those determinations are made in the course of Step 3 by the National Marine Fisheries Service and the Fish and Wildlife Service (referred to as The Services) using additional information not considered in Steps 1 and 2.

Step 3 is part of the formal consultation process. Here, the Services prepare a biological opinion (BiOp), which builds upon EPA’s BE to determine whether the potential adverse effect is likely to jeopardize the continued existence of a species or destroy or adversely modify critical habitat. The analysis in Step 3 considers whether the anticipated adverse effects to individuals described in the BE will negatively affect populations and the species they comprise such that they jeopardize the continued existence of the species.

These documents reflect the final biological evaluation for simazine. In regard to addressing public comments and initiating consultation with the Services under Section 7, EPA carefully considered the comments to determine if any updates to the BEs were necessary. In many cases the information or data submitted in the comments is expected to have little bearing on the likelihood of impacting one individual, considering the conservative nature of the NE/LAA/NLAA determinations. Early in the consultation, we plan to identify species that may need additional data refinements to be used when considering mitigation options. Where we received public comments and/or data that are useful for these purposes, we will consider it at that time.

# 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. Prior to the completion of the November 2020 draft BE, the technical registrants indicated their intent in the form of commitment letters (see **APPENDIX 1-2**) to update the simazine formulated product labels to reflect 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). EPA will complete the review and approval of product labels reflecting the requested amendments by November 12, 2021. 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 herbicide with current registrations in the United States (atrazine), 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 two 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 simazine product labels are limited to use only in the 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, MA, NLAA, or LAA)[[4]](#footnote-5) for 1795 listed species, and 792 designated critical habitats. Under Step 1, EPA made NE determinations for 680 species and 424 critical habitats because there was either no overlap between the species range/critical habitat and the action area or no discernable effects are reasonably expected to occur. 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 registrants (**APPENDIX 1-2**). EPA made MA determinations for 1115 species and 368 critical habitats. As explained above, all species and critical habitats with a MA determination progressed to the Step 2 analysis where an NLAA or LAA determination is made[[5]](#footnote-6). In Step 2, EPA made NLAA determinations for 122 species and 52 critical habitats. EPA made LAA determinations for 993 species and 316 critical habitats. Specific species determinations are provided in **APPENDIX 4-1.**

For each LAA determination, EPA also grouped these determinations into three categories (*i.e.,* strongest, moderate and weakest) which 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, whether impacts could occur due to direct toxicity to the species or to both direct toxicity and to its prey, pollination, habitat, and dispersal (PPHD), the presence of reported incidents involving the species taxa or PPHD taxa, the presence of monitoring data that exceeds endpoints, whether species’ habitats are potential use sites or if they could only be exposed from 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, there were uncertainties in the simazine effects determinations based on the resolution of spatial data. For species and critical habitats, there were uncertainties in the resolution of spatial data, resolution of usage data and the threshold for assessing impacts on PPHD (detailed in **Chapter 4**).**Table 1** and **Table 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. https://www3.epa.gov/pesticides/nas/revised/revised-method-march2020.pdf [↑](#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. NE = No effect. MA = May affect. NLAA = Not likely to adversely affect. LAA = Likely to adversely affect. [↑](#footnote-ref-5)
5. Available at: <https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional> [↑](#footnote-ref-6)