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Environmental Protection Agency  
Agency Docket Center (EPA/DC)  
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Washington, DC 20460-0001  
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**EPA-HQ-OPP- 2013-0266-1274, Simazine (EPA-HQ-OPP- 2013-0251-0146), and Propazine (EPA-HQ-OPP-2013-0250-009)**

To whom it may concern:

Center for Food Safety (CFS), on behalf of itself and its 970,000 members and supporters, submit these comments in response to the Environmental Protection Agency's (EPA) Atrazine, Propazine, and Simazine Proposed Interim Registration Review Decision in Case No. 0062.<sup>1</sup> CFS is a public interest, nonprofit membership organization with offices in Washington, D.C., San Francisco, California, and Portland, Oregon. CFS's mission is to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture. Through groundbreaking legal, scientific, and grassroots action, CFS protects and promotes the public's right to safe food and the environment. CFS has consistently supported comprehensive EPA review of registered pesticides and individual inert ingredients.

## **I. Background**

Pursuant to Section 3(g) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and EPA's regulations implementing FIFRA, EPA is currently in the process of reviewing the registration of atrazine.<sup>2</sup> EPA opened the registration review docket for atrazine via a notice published in the Federal Register on June 26, 2013.<sup>3</sup> On January 2, 2020, EPA published a notice in the Federal Register, announcing the availability and soliciting public input on the proposed interim registration review decisions for atrazine. CFS submits the following comments concerning issues that EPA should consider in its proposed interim decision of atrazine as part of the registration review process. Non-EPA documents cited in these comments that have not been submitted previously are also being submitted.

## **II. Relevant Legal Standards**

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<sup>1</sup> Although EPA's proposed interim registration review decision is for several triazines, including atrazine, propazine, and simazine, for simplicity's sake, only atrazine will be referenced in this comment letter.

<sup>2</sup> See 40 C.F.R. Part 155, subpart C.

<sup>3</sup> 78 Fed. Reg. 38328 (June 26, 2013).

## A. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Under FIFRA, EPA must approve, or “register,” pesticides before they are used or sold.<sup>4</sup> In order to for a pesticide to be registered, EPA must conclude a pesticide will, *inter alia*, “not generally cause unreasonable adverse effects on the environment.”<sup>5</sup> FIFRA defines “unreasonable adverse effects on the environment” as “any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide.”<sup>6</sup>

Once a pesticide is registered, FIFRA section 3(g) requires EPA to review that registration at least every 15 years in accordance with regulations the agency promulgates.<sup>7</sup> The legislative history of this provision indicates that Congress intended EPA to “periodically review the registration of each pesticide” to account for “the rapid development of science” and to use that knowledge to better understand how a pesticide “impacts human health and the environment[.]”<sup>8</sup> EPA published its procedural regulations for registration review in August 2006.<sup>9</sup> Pursuant to these regulations, EPA must “ensure that each pesticide registration continues to satisfy the FIFRA standard for registration.”<sup>10</sup> That is, registration review requires EPA to reaffirm its determination that “a pesticide generally will not cause unreasonable adverse effects on the environment.”<sup>11</sup> This requires EPA “to ensure that each pesticide’s registration is based on current scientific and other knowledge regarding the pesticide, including its effects on human health and the environment.”<sup>12</sup> *Id.* If a product “fails to satisfy the FIFRA standard for registration, the product’s registration may be subject to cancellation or other remedies under FIFRA.”<sup>13</sup>

When EPA initiates review of a registered pesticide, it establishes a docket for “information that will assist the public in understanding the types of information and issues that the Agency may consider in the course of the registration review.”<sup>14</sup> This information includes, but is not limited to:

- An overview of registration review case status;
- A list of current registrations and registrants, any Federal Register notices regarding pending registration actions, and current or pending tolerances;
- Risk assessment documents;
- Bibliographies concerning current registrations;

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<sup>4</sup> 7 U.S.C. § 136a(a).

<sup>5</sup> *Id.* § 136a(c)(5)(D).

<sup>6</sup> *Id.* § 136(bb).

<sup>7</sup> *Id.* § 136a(g)(1).

<sup>8</sup> H.R. Rep. 104-669, at 1212 (1996).

<sup>9</sup> *See* 71 Fed. Reg. 45720 (Aug. 9, 2006).

<sup>10</sup> 40 C.F.R. § 155.40(a); *see also* 40 C.F.R. § 155.53(a).

<sup>11</sup> *Id.* § 155.40(a)(1).

<sup>12</sup> *Id.*

<sup>13</sup> *Id.* § 155.40(a)(2).

<sup>14</sup> 40 C.F.R. § 155.50(a).

- Summaries of incident data; and
- Any other pertinent data or information.<sup>15</sup>

Upon initiating and placing this information in the docket, EPA invites public comment and requests “data or information that it does not have but which may be useful, if available, for consideration in the registration review.”<sup>16</sup> Data or information submissions to EPA must be presented in a legible and usable form and must clearly identify sources.<sup>17</sup> Submitters may also request EPA to reconsider data or information that the agency rejected in a previous review.<sup>18</sup>

During registration review, EPA “will assess any changes that may have occurred since the Agency’s last registration decision in order to determine the significance of such changes and whether the pesticide still satisfies the FIFRA standard for registration.”<sup>19</sup> EPA must consider:

- Whether to conduct a new risk assessment to take into account any changes in statutes or regulations, policy, risk assessment procedures or methods, or data requirements;
- Whether any new data or information on the pesticide warrant conducting a new risk assessment or a new risk/benefit analysis;
- Whether any new data or information regarding an individual pesticide product warrant additional review of a pesticide product’s registration.<sup>20</sup>

If EPA determines that a new assessment is needed, it will determine whether it can base the new assessment on available data or information.<sup>21</sup> If sufficient data or information are available, EPA conducts the new risk assessment or risk/benefit assessment.<sup>22</sup> If EPA determines that additional data or information are needed to conduct the review, the agency issues a Data Call-In notice.<sup>23</sup> EPA generally makes available and invites comment on new and revised risk assessments.<sup>24</sup>

Before completing a registration review, EPA may issue, when it determines it to be appropriate, an interim registration review decision (IRRD).<sup>25</sup> Among other things, the IRRD may:

- Require new risk mitigation measures;
- Impose interim risk mitigation measures;
- Identify data or information required to complete the review;

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<sup>15</sup> *Id.*

<sup>16</sup> *Id.* § 155.50(b)-(c).

<sup>17</sup> *Id.* § 155.50(c).

<sup>18</sup> *Id.*

<sup>19</sup> *Id.* § 155.53(a).

<sup>20</sup> *Id.*

<sup>21</sup> *Id.* § 155.53(b)(1).

<sup>22</sup> *Id.*

<sup>23</sup> *Id.*

<sup>24</sup> *Id.* § 155.53(c).

<sup>25</sup> *Id.* § 155.56.

- Include schedules for submitting the required data, conducting the new risk assessment and completing the registration review.<sup>26</sup>

EPA follows the same procedures for issuing an IRRD as it does for issuing a registration review decision (RRD).<sup>27</sup>

Whether EPA issues an IRRD or an RRD, it must first publish a proposed decision and allow at least 60 days for public comment.<sup>28</sup> In the proposed decision, EPA must, among other things:

- State its proposed findings with respect to the FIFRA standard for registration and its rationale;
- Identify proposed risk mitigation measures or other remedies as needed and describe its rationale;
- State whether it believes that additional data are needed and, if so, describe what is needed;
- Specify proposed labeling changes;
- Identify deadlines for completing any required actions.<sup>29</sup>

After considering comments on the proposed decision, EPA will issue an IRRD or RRD.<sup>30</sup> EPA must explain any changes to the proposed decision and provide a response to significant comments.<sup>31</sup> The registration review docket remains open “until all actions required in the final decision on the registration review case have been completed.”<sup>32</sup>

#### B. Federal Food, Drug, and Cosmetic Act (FFDCA)

The FFDCA<sup>33</sup> prohibits the introduction of “adulterated” food into interstate commerce.<sup>34</sup> The Act requires that where use of a pesticide will result in any pesticide residue being left on food, EPA must either set a “tolerance” level for the amount of allowable pesticide residue that can be left on the food, or set an exemption of the tolerance requirement.<sup>35</sup> The tolerance requirements are established for the combined residues of the herbicide atrazine and its chlorinated metabolites in or on a number of food commodities, including varieties of sweet corn, sorghum, field corn, and sugarcane.<sup>36</sup> Additionally, tolerances are established for indirect

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<sup>26</sup> *Id.*

<sup>27</sup> *Id.*

<sup>28</sup> *Id.* § 155.58(a).

<sup>29</sup> *Id.* § 155.58(b).

<sup>30</sup> *Id.* § 155.58(c).

<sup>31</sup> *Id.*

<sup>32</sup> *Id.*

<sup>33</sup> 21 U.S.C. § 301 *et seq.*

<sup>34</sup> 21 U.S.C. § 331.

<sup>35</sup> 21 U.S.C. § 346a(1).

<sup>36</sup> 40 C.F.R. § 180.220(a).

or inadvertent residues of atrazine in or on the raw agricultural commodity<sup>37</sup> listed under “group 4 leafy vegetables, except *Brassica*.”<sup>38</sup>

The FFDCA mandates EPA to “establish or leave in effect a tolerance for a pesticide chemical residue in or on a food only if the EPA Administrator determines that the tolerance is safe.”<sup>39</sup> For a tolerance level to be “safe,” the statute requires EPA determine “that there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposures and all other exposures for which there is reliable information.”<sup>40</sup> “Aggregate exposure” includes not only dietary exposure through food consumption, but also includes “exposures through water and residential uses.”<sup>41</sup>

### C. Food Quality Protection Act (FQPA)

In 1996, Congress passed the Food Quality Protection Act (FQPA), which amended FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA). When determining the safety of a pesticide chemical under the FQPA, EPA “shall base its assessment of the risk posed by the pesticide chemical on *aggregate* (i.e., total food, drinking water, residential, and other nonoccupational) exposure to the pesticide.”<sup>42</sup> “EPA is also required to consider available information concerning the *combined* toxic effects to human health that may result from dietary, residential, or other nonoccupational exposure to chemicals that have a common mechanism of toxicity.”<sup>43</sup>

Furthermore, “[i]n establishing, modifying, leaving in effect, or revoking a tolerance or exemption for a pesticide chemical residue,” FQPA requires that EPA “ensure[s] that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide chemical residue” by applying “an additional tenfold margin of safety for the pesticide chemical residue and other sources of exposure . . . for infants and children to take into account potential pre- and post-natal toxicity and completeness of the data with respect to exposure and toxicity to infants and children.”<sup>44</sup>

### D. Safe Drinking Water Act (SDWA)

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<sup>37</sup> 21 U.S.C. § 321(r) defines “raw agricultural commodities” as “any food in its raw or natural state, including all fruits that are washed, colored or otherwise treated in their unpeeled natural form prior to marketing.”

<sup>38</sup> 40 C.F.R. § 180.220(d).

<sup>39</sup> 21 U.S.C. § 342(a)(2)(A) (emphasis added); *see also* 40 C.F.R. § 180.1(f).

<sup>40</sup> 21 U.S.C. § 346(a)(2)(A)(ii).

<sup>41</sup> *Natural Res. Def. Council v. Whitman*, No. C 99-03701-WHA, 2001 WL 1221774 (N.D. Cal. Nov. 7, 2001).

<sup>42</sup> EPA, *Guidance on Cumulative Risk Assessment of Pesticide Chemicals That Have a Common Mechanism of Toxicity*, at 5 (Jan. 14, 2002) (emphasis in original); *see* 21 U.S.C. § 346a(b)(2)(A)(ii).

<sup>43</sup> *Id.* (emphasis in original); *see* 21 U.S.C. § 346a(b)(2)(D)(v).

<sup>44</sup> 21 U.S.C. § 346a(b)(2)(C)(ii), *see also* EPA, *Summary of the Food Quality Protection Act*, <https://www.epa.gov/laws-regulations/summary-food-quality-protection-act>.

In the early 1990s, atrazine's occurrence in the environment resulted in the EPA's Office of Water (OW) to regulate atrazine under the SDWA. OW established a Maximum Contaminant Level (MCL) of 3 parts per billion (ppb) for atrazine (also expressed as 0.003 mg/L or 3 µg/L) in 1991.<sup>45</sup> Under the SDWA, atrazine has been subject to compliance monitoring, and the MCL of 3 ppb for atrazine applies to "community water systems and non-transient, non-community water systems."<sup>46</sup> MCL's are enforceable under the SDWA.

#### E. EPA's Duties Under the Endangered Species Act (ESA)

The ESA requires EPA, in consultation with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS), to ensure that any actions by the agency, here including, but not limited to, completing Registration Review for atrazine, are not likely to jeopardize the continued existence of any threatened or endangered species, or result in the destruction or adverse modification of the critical habitat of such species.<sup>47</sup> For each federal action, EPA must request information from FWS and NMFS indicating whether any listed or proposed species may be present in the area of the agency action.<sup>48</sup> If listed or proposed species may be present, EPA must prepare a "biological assessment" to determine whether the listed species may be affected by the proposed action.<sup>49</sup>

If EPA determines that its proposed action may affect any listed species or critical habitat, the agency must engage in formal consultation with FWS and/or NMFS. Effects determinations are based on the direct, indirect, and cumulative effects of the action when added to the environmental baseline and other interrelated and interdependent actions.<sup>50</sup> An agency is required to review its actions "at the earliest possible time" to determine whether the action may affect listed species or critical habitat.<sup>51</sup> Because EPA retains ongoing discretionary authority to modify the terms and conditions of its approvals, the agency's continuing authority over pesticide registrations constitutes an ongoing agency action and it has a continuing obligation to follow the requirements of the ESA.

To complete formal consultation, FWS/NMFS must provide EPA with a "biological opinion" explaining how the proposed action will affect the listed species or habitat.<sup>52</sup> If FWS/NMFS concludes the proposed action will jeopardize the continued existence of a listed species, the biological opinion must outline "reasonable and prudent alternatives."<sup>53</sup> If the biological opinion concludes the action is not likely to jeopardize the continued existence of a listed species, and it will not result in the destruction or adverse modification of critical habitat, FWS/NMFS must provide an incidental "take" statement specifying the impact of such

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<sup>45</sup> 56 Fed. Reg. 3594 (Jan. 30, 1991); *see also* 40 C.F.R. § 141.61(c).

<sup>46</sup> *Id.*

<sup>47</sup> 16 U.S.C. § 1536(a)(2).

<sup>48</sup> 16 U.S.C. § 1536(c)(1); 50 C.F.R. § 402.12.

<sup>49</sup> *Id.*

<sup>50</sup> 50 C.F.R. § 402.02.

<sup>51</sup> 50 C.F.R. § 402.14(a).

<sup>52</sup> 16 U.S.C. § 1536(b).

<sup>53</sup> *Id.* § 1536(b)(3)(A).

incidental taking on the listed species and any “reasonable and prudent measures” that FWS/NMFS consider necessary or appropriate to minimize such impact, and also setting forth the “terms and conditions” that must be complied with by EPA to implement those measures.<sup>54</sup>

During consultation with FWS/NMFS, EPA is prohibited from making any irreversible or irretrievable commitment of resources with respect to the agency action which may foreclose the formulation or implementation of any reasonable and prudent alternative measures.<sup>55</sup> ESA Section 7 also requires EPA, in consultation with and with the assistance of FWS/NMFS, to utilize its authority in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species.<sup>56</sup>

### **III. Purpose of Registration Review**

EPA is undertaking a registration review of atrazine. Mandated by FIFRA, the purpose of the registration review program is to provide EPA with an opportunity to periodically (every 15 years) assess the risks that a pesticide may pose to human health and the environment in the light of new scientific information, enhanced ability to detect risks, changes in pesticide policy, and alterations in pesticide usage practices, since the pesticide was last registered. The first product containing atrazine was registered in 1958, and therefore atrazine was subject to reregistration.<sup>57</sup>

### **IV. EPA cannot proceed to a final decision without first providing the public with a complete proposed decision and soliciting additional public comment.**

Under its registration review procedures, EPA “may issue, when it determines it to be appropriate, an interim registration review decision before completing a registration review.”<sup>58</sup> According to EPA, following the close of the current 60-day comment period, if EPA does not make any changes to the PIRRD, it “may issue an interim registration review decision for atrazine.”<sup>59</sup> However, EPA also states that “a final decision for atrazine may be issued without the agency having previously issued an interim decision.”<sup>60</sup> In other words, EPA claims that it can proceed directly from a “proposed interim decision” to a final decision without any other opportunity for public comment. This undermines the public commenting process because, as EPA itself acknowledges, the PIRRD lacks significant information about endangered species, pollinators, and endocrine disruption.<sup>61</sup>

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<sup>54</sup> *Id.* § 1536(b)(4).

<sup>55</sup> 16 U.S.C. § 1536(d).

<sup>56</sup> 16 U.S.C. § 1536(a)(1).

<sup>57</sup> PIRRD at 5.

<sup>58</sup> 40 C.F.R. § 155.56.

<sup>59</sup> PIRRD at 47.

<sup>60</sup> *Id.*

<sup>61</sup> *Id.* at 8, 46-47 (“EPA will address concerns specific to atrazine particularly with regard to pollinators, ESA, and endocrine disruption, in connection with the development of its final registration review decision for this pesticide.”).

EPA can register a pesticide only upon determining that “it will perform its intended function without unreasonable adverse effects on the environment,”<sup>62</sup> and that “when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment.”<sup>63</sup> Through registration review, EPA must “ensure that each pesticide registration continues to satisfy the FIFRA registration standard.”<sup>64</sup> This requires that “each pesticide’s registration is based on current scientific and other knowledge regarding the pesticide, including its effects on human health and the environment.”<sup>65</sup>

It is essential that EPA disclose to the public in a timely manner the “current scientific and other knowledge regarding the pesticide” so that members of the public can make informed comments.<sup>66</sup> EPA cannot abuse the registration review process by forcing the public to comment on a woefully incomplete PIRRD only to proceed to a final decision once the missing data is supplied but without any further opportunities for public comment.

It is also inconsistent with EPA’s regulations. For example, according to EPA’s regulations, “[a]mong other things, the interim registration review decision may require new risk mitigation measures, impose interim risk mitigation measures, *identify data or information required to complete the review, and include schedules for submitting the required data, conducting the new risk assessment and completing the registration review.*”<sup>67</sup> As stated above, EPA acknowledges that the PIRRD is missing critical information on endangered species, pollinators, and endocrine disruption that the public has a right to see and comment on *before* EPA “complet[es] the registration review.” In addition, 40 C.F.R. 155.58(b)(3) provides that when additional data is needed, as it is here, a notice requiring such data may be issued “in conjunction with a proposed or final decision on the registration review case *or a proposed or final interim decision* on a registration review case.” Thus, the regulations specifically contemplate that a “final interim decision” follows the “proposed interim decision” rather than moving straight to a “final decision” on registration review as EPA suggests it can do.

Furthermore, EPA cannot terminate the Atrazine Monitoring Program (AMP) without proper public notice and comment.<sup>68</sup> The AMP water monitoring program was created and agreed to by technical registrants of atrazine via the 2004 Memorandum of Agreement.<sup>69</sup> The

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<sup>62</sup> 7 U.S.C. § 136a(c)(5)(C).

<sup>63</sup> *Id.* § 136a(c)(5)(D).

<sup>64</sup> 40 C.F.R. § 155.40(a).

<sup>65</sup> *Id.* § 155.40(a)(1).

<sup>66</sup> *Ohio Valley Env'tl. Coal. v. U.S. Army Corps of Eng'rs*, 674 F.Supp.2d 783, 808 (S.D.W.V. 2010) (absence of substantive information in agency notice “shielded essential data and detail from public review and comment and prevented the public from commenting intelligently on the adverse impacts[.]”).

<sup>67</sup> 40 C.F.R. § 155.56 (emphasis added).

<sup>68</sup> PIRRD, at 34-35.

<sup>69</sup> 2004 EPA Memorandum of Agreement Between the U.S. Environmental Protection Agency and Agan Chemical Manufacturing, Dow AgroSciences, Drexel Chemical, Oxon Italia S.P.A., and Syngenta Crop Protection Concerning the Registration of Products Containing Atrazine. 2004.



AMP monitors community drinking water systems, mostly in the Midwest United States in areas of high atrazine use, to assess atrazine levels in surface drinking water sources. EPA has decided to suspend the requirements of the AMP for the calendar year 2020 without first proposing and seeking public comment on this action.<sup>70</sup>

## **V. Introduction**

Atrazine is one of the most intensively studied pesticides because of its many known and suspected harms to human health and the environment.<sup>71</sup> These harms are attributable to several factors. Atrazine is used intensively, with estimated agricultural use ranging from about 65 to over 80 million lbs./year since the early 1990s, making it second only to glyphosate among conventional pesticides in amount used. Atrazine is also deployed extensively in most corn-growing regions but also to sorghum, sugarcane and increasingly to turf. Atrazine and its metabolites, which have equivalent toxicity, are persistent, leach into water bodies, and are widely detected in both the environment and in drinking water sources. Finally, atrazine is an extremely potent endocrine-disrupting compound that exerts profound effects on humans, plants, animals and ecosystem health at vanishingly small concentrations measured in the parts per billion and even parts per trillion.

EPA has wrestled with atrazine for many years now, convening numerous Scientific Advisory Panels (SAPs) to advise it on particular questions regarding its impacts on human health or the environment. EPA's latest human health and environmental assessments also acknowledge the existence of and offer brief summaries of independent, peer-reviewed literature on atrazine, attention that is often lacking in EPA's assessments of other pesticides. However, despite the SAPs and EPA's capsule descriptions of literature studies, in the end EPA's regulatory determinations for atrazine were overwhelmingly based, as usual, on studies conducted or commissioned by the pesticide industry (e.g. see Boone et al. 2014).

## **VI. EPA almost exclusively relied on industry studies and ignored peer-reviewed literature for its risk assessments.**

Peer-reviewed literature did not have any impact on EPA's human health risk assessment of atrazine or in particular the evaluation of epidemiological studies related to atrazine and atrazine's carcinogenic potential.

EPA's dismissal of informed comments and independent scientific studies that undergo peer review on mostly spurious grounds in favor of industry studies where conflicts of interest present obvious motivations for bias and fraud is unacceptable (Rohr and McCoy 2010a). EPA relies heavily on the use of Good Laboratory Practices (GLP) as a false marker of scientific quality, yet GLP standards are mostly procedural and record-keeping requirements that were first instituted by federal agencies in response to massive fraud on the part of private testing firms conducting studies on behalf of corporate clients seeking regulatory approval of their products

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<sup>70</sup> EPA PIRRD 2019, at 35.

<sup>71</sup> A search on "atrazine" in PubMed turns up 4,634 hits, compared to e.g. 3,409 for glyphosate (search conducted on 2/28/20).

(Myers et al. 2010). GLP does not ensure scientific quality; peer review of studies by independent scientists is a far better guarantor.

A 2012 Scientific Advisory Panel on atrazine took EPA to task for the excessively stringent criteria it applied in screening out peer-reviewed studies: “In the view of the Panel, the test design elements should not be applied so strictly to the published literature as to disqualify all studies that do not meet all of these criteria... In the Panel’s analysis, the EPA’s strict application of the test design elements to the published literature was flawed and many of the test design elements should be relaxed for review of the published literature.” The Panel also stressed that such independent studies could be “very useful in risk assessment (even quantitative assessment), even if some of these design elements are not met” (SAP 2012, pp. 15, 30). The same of course is true of EPA’s risk assessment of atrazine.

The statutory standard requiring sufficient data to support a finding that atrazine will not pose any unreasonable adverse effects on the environment therefore has not been met.

## **VII. Atrazine and Human Health Concerns**

### **A. Mechanisms of Action**

EPA has identified atrazine’s attenuation of the luteinizing hormone (LH) surge as the early key event in atrazine’s toxicity pathway. LH is a critical reproductive hormone in both females and males. Based on its review of various animal studies, EPA determined that early-life exposure to atrazine disrupts regular ovarian cycles in females, reduces testicular hormone secretion in males, triggers developmental defects in genitalia, causes pregnancy loss (litter resorptions), delays the onset of puberty in both sexes, and triggers prostate inflammation. The critical exposure windows for these effects are in utero (impacts manifested in offspring) or the early post-natal period, with a mere four days of exposure sufficient to elicit them. Longer exposure to atrazine (30 days) shortly before or during puberty can also delay sexual maturation in rats. Reproductive-age females exposed to atrazine are subject to disruption of ovarian cycles.

Other animal studies demonstrate that atrazine demasculinizes male gonads in multiple species of mammals, amphibians, reptiles and fish and induces partial and/or feminization in fish, amphibians and reptiles at very low doses, with eight identified mechanisms of action that involves reductions in androgen levels and induction of estrogen synthesis (reviewed in Hayes et al. 2011, Figure 4, Section 1.5h; Hayes et al. 2010, 2006a). EPA focuses solely on one of these pathways, attenuation of the luteinizing hormone surge, and thus may well be missing toxic effects occurring via other mechanisms at lower doses.

EPA also seems to neglect studies that involve exposure of animals to atrazine and its metabolites. This is a curious omission, since EPA acknowledges that human exposure (e.g. in water) includes both atrazine and its metabolites, and moreover regards these metabolites – desethyl-s-atrazine (DEA), desisopropyl-s-atrazine (DIA), diaminochlorotriazine and hydroxyatrazine – as equivalent in toxicity to atrazine, and nominally at least includes them in its cumulative assessment (EPA PIRRD 2019, p. 5). Yet several animal studies on mixtures of

atrazine and these metabolites, in proportions reflective of their occurrence in the environment, were not included in EPA's draft human health assessment.

Enoch et al. (2007) exposed pregnant rats to three doses of such an atrazine-metabolites mixture on gestation days 15 to 19. Female offspring suffered significant delays in mammary gland development at all doses, including the low dose of 0.09 mg/kg bw/day, from postnatal days 4 to 60. Male offspring suffered delays in onset of puberty (as measured by time to preputial separation) and prostate inflammation on postnatal day 120 at all doses (Stanko et al 2010). The researchers, who included EPA research scientists, suggested that the mixture and/or individual metabolites have different and greater toxicity than atrazine alone. Indeed, the lowest mixture dose in this study of 0.09 mg/kg bw/day – which is somewhat greater than the unknown LOAEL – is over 30-fold lower than EPA's point of departure for atrazine alone, the NOAEL/LOAEL of 1.56/3.12 mg/kg bw/day derived from Cooper et al. (2010). This suggests that EPA's safety threshold is far too high, neglecting the potential for impacts from real-world exposure to mixtures of atrazine and its metabolites at far lower doses than atrazine alone.

B. EPA ignores or discounts significant adverse effects on human health.

*i. Adverse Birth Outcomes, Birth Defects and Reproductive Effects*

These toxicological investigations of animal responses to this potent endocrine disruptor and its metabolites are complemented by numerous human epidemiology studies. EPA purported to review 93 of them (1990 to 2017) as part of its “weight-of-the-evidence” assessment of atrazine (EPA 7/9/18). Yet not a single one of these 93 epidemiology studies was accorded any weight at all in EPA's evaluation, typical of EPA's dismissive attitude to the science of epidemiology in virtually all of its pesticide evaluations. Eight-one (81) studies were immediately excluded as not “fit for purpose.” EPA provides summaries of the other 12 presumably “fit for purpose” studies, which the Agency initially found were “of a moderate or high quality study design,” but in the end contradicts itself by dismissing each of them as low quality with the formulaic: “Overall, the epidemiological evidence is limited but insufficient at this time to conclude that there is a clear associative or causal relationship between atrazine exposure and [endpoint]” (Ibid., p. 7, pp. 11 ff). EPA's use of “overall” is a misnomer, and points to a fundamental flaw in its assessment paradigm. The Agency did not conduct an “overall” evaluation; rather, each study was evaluated in isolation, with only two possible outcomes: yes, this single study demonstrates that atrazine causes [toxicological endpoint]; or no, the study's results are meaningless, entirely to be discounted, and have no bearing on [toxicological endpoint]. While EPA does not make this dichotomous approach explicit, and in fact goes to great lengths to project the image of conducting a true “weight-of-the-evidence” assessment, the reality is clear: epidemiology had not the slightest influence on EPA's regulatory determination with respect to atrazine.

A true weight of the evidence approach would involve a scoring system in which individual studies are given scores along a continuum (e.g. a five- or ten-point scale) reflecting the balance of their strengths and weaknesses; and the “overall” evaluation would in some way sum up the scores. A single weak study would carry little weight, but multiple weaker studies

pointing to the same general effects (e.g. adverse birth outcomes) would carry greater collective weight.

The bankruptcy of EPA's approach is particularly clear in view of the many human epidemiology studies demonstrating that exposure of expectant mothers to atrazine increases the risks their offspring will suffer just the sorts of hormone-related adverse birth and reproductive outcomes that one would expect from the animal experiments referred to above.

#### Adverse birth outcomes

- \* Birth defects: Agopian (2013a,b,c); Waller et al. (2010); Mattix et al. (2007)
- \* Fetal growth reduction, small head circumference: Chevrier et al. (2011)
- \* Low birth weight: Almberg et al. (2018)
- \* Preterm birth: Rinsky et al. (2012), Stayner et al. (2017), Savitz et al. (1997)<sup>72</sup>
- \* Small for gestational age: Ochoa-Acuna et al. (2009), Villaneuva et al (2005), Munger et al. (1997)

#### Reproductive effects

- \* Irregular menstrual cycles: Cragin et al. (2011)
- \* Increased risk of spontaneous abortion: Arbuckle et al. (2001)

In addition, Winchester et al. (2009) demonstrated increased incidence of total birth defects and 11 of 22 types of birth defect in babies conceived in the months (April to July) when atrazine and overall agrichemical concentrations in U.S. surface waters are highest, with conception pegged to last menstrual period. Mattix et al. (1997) demonstrated similar results for Indiana: a correlation between monthly abdominal wall defects in infants conceived in the season of peak atrazine concentrations in the state's surface waters. These studies build upon others that similarly show increased incidence of birth defects in infants when parental exposure at time of conception coincides with regions and season (spring) of most intensive pesticide use and exposure (e.g. Garry et al. 1996).

EPA dismisses some of these studies because they utilize proxy measures of atrazine exposure derived from various datasets on atrazine levels in surface waters and drinking water sources, including the EPA-mandated Atrazine Monitoring Program (AMP). (One wonders what the point of the AMP has been, if studies utilizing the data it generates are to be automatically dismissed.) EPA itself utilizes these atrazine monitoring data (in combination with modeling) for the exposure side of its own regulatory determinations. Yet utilizing such data suddenly become grounds for dismissal in the singular context of epidemiology studies. EPA is not really concerned with potential imprecision in exposure estimates that come from using these data. This is indicated by the fact that EPA dismisses studies even when researchers measure atrazine and its metabolites in the urine of study subjects, providing a more reliable measure of atrazine exposure that correlates with adverse outcomes (e.g. Chevrier et al. 2011, Cragin et al. 2011).

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<sup>72</sup> The association in Savitz et al. (1997) was between male farmers' exposure to atrazine in the months prior to conception and preterm birth.

Neither does EPA attempt to integrate human epidemiological findings with the results of animal experiments or mechanisms of toxicity. This deficiency is particularly striking when the outcomes of animal and human studies precisely coincide. For instance, EPA highlighted irregular menstrual cycles as a key effect of atrazine exposure in rodents (EPA 7/10/18, pp. 29-31), while Cragin et al. (2011) found strongly increased risk of irregular menstrual cycles in women more highly exposed to atrazine. Farr et al. (2004) similarly found 2- to 3-fold higher risk of long menstrual cycles and missed periods, and 60 to 70% higher risk of intermenstrual bleeding, among women of the Agricultural Health Study who used atrazine.<sup>73</sup> Clearly, the findings of the animal and two epidemiology studies are mutually supportive. The entire purpose of animal studies is to predict human harms and investigate potential mechanisms for them, and so the animal study obviously increases confidence in concordant epidemiological results, absent some specific biological reason demonstrating that the mode of action in the animal species is not operative in human beings. Nevertheless, nowhere in EPA's human health analyses are these findings discussed in an integrated manner. The Agency dismissed Farr et al. (2004) from the start because it did not entirely isolate the effects of atrazine (see preceding footnote and EPA 7/10/18, p. 189). Of course, there is a large and growing literature on the additive effects of endocrine disruptors, particularly with respect to reproductive endpoints, and exposure to multiple pesticides is the rule rather than exception in the real world. Nor does the Agency grant the Cragin et al. (2011) study even the slightest bit of evidential "weight" despite the concordant animal results (e.g. *Ibid.*, pp. 41-42, 168; EPA 7/9/18, pp. 22-24). In contrast to EPA, Farr et al. (2004) understand the need to integrate animal and human findings:

"The three pesticides with the strongest effects on the ovary, the estrous cycle, or reproductive hormones in toxicology studies—lindane, atrazine, and mancozeb or maneb—also seemed to have strong associations in the current study" (Farr et al. 2004, p. 1202).

Neither does EPA show any interest in whether atrazine's degradation of human sperm quality (reductions in the concentration and motility of sperm, as well as higher percentage of abnormal sperm), as documented in Swan et al. (2003a, b), might have anything to do with the increased risk of preterm delivery in the spouses of Ontario farmers exposed to atrazine just prior to conception (Savitz et al. 1997).

These are illustrative examples. There are surely many more that could be found. While independent scientists strive to understand the implications of animal study results for human health, and conversely explore whether or to what extent epidemiological findings find support in concordant animal study outcomes, EPA is firmly committed to a strict division between the two research realms. Animal studies alone count, but only to establish maximum safety thresholds, full stop. Human epidemiology studies and incident data are simply dismissed. This is so despite EPA's dual pretenses of developing a framework that integrates the two, and conducting a weight-of-the-evidence evaluation.

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<sup>73</sup> See Farr et al. (2004), Table 5: data in rows "Probable hormonally active pesticides," which includes lindane, atrazine, mancozeb or maneb; and "Lindane, atrazine, excluding mancozeb or maneb."

ii. *Food Quality Protection Act Safety Factor*

EPA ignored safety precautions mandated under FQPA that protect young children from exposure to pesticides, such as atrazine. In EPA's *Atrazine: Draft Human Health Risk Assessment for Registration Review (2018)*, the agency discarded FQPA's 10-fold safety factor meant to protect children and fetuses from harm (reducing it from 10X to 1X) and reduced the safety factor put in place to account for uncertainty of using animal data to estimate harm to humans from 10-fold to 3-fold based on modeling developed by Syngenta. The agency's decision to dispose of the FQPA safety factor and inter-species extrapolation uncertainty factor is arbitrary and should be reversed.

In its assessment of the hazards of pesticides, EPA is required by the Food Quality Protection Act (FQPA) of 1996 to apply "an additional tenfold margin of safety" to account for "the special susceptibility of infants and children," and in particular the "potential for pre- and postnatal toxicity..." and reduce or eliminate this safety factor only if "reliable data" demonstrate it is not needed (21 U.S.C. § 346a(b)(2)(C)(ii)). According to EPA policy implementing the FQPA, the 10x FQPA safety factor is to be applied when the young exhibit increased susceptibility to a pesticide (i.e. effects not seen in adult animals) or when they exhibit increased sensitivity to the pesticide (the effects occur at lower doses or increased severity in the young) (EPA 2002a, p. 30). Yet despite this mandate, EPA quite often fails to apply the FQPA safety factor in situations that demand it (Thayer & Houlihan 2004, pp. 288-90).

Atrazine is a reproductive and developmental toxin. Many of the animal studies that form the basis of EPA's evaluation of atrazine involve *in utero* or early postnatal exposure that triggers adverse effects to offspring later in life, for instance delays in pubertal development, adverse effects on development of male genitalia, and disruption of prostate function (EPA PIRRD 2019, pp. 32-34). Atrazine's reproductive toxicity is evidenced by litter resorptions (pregnancy loss) when administered to F344 rats during the period of pregnancy sensitive to luteinizing hormone (Ibid., p. 29). The epidemiology on adverse birth outcomes and birth defects cited above provides additional strong evidence of the increased susceptibility and sensitivity of the young relative to adult animals that requires application of the FQPA safety factor.

EPA's major rationale for reducing the FQPA factor to 1x (i.e. eliminating it)<sup>74</sup> is that it has "reliable data" that safety thresholds established without the FQPA factor are safe for infants and children. However, this assertion is based on several false premises. First, EPA entirely discounts the human epidemiology studies discussed above, which demonstrate a wide range of adverse birth outcomes from pre- and postnatal exposure. Second, EPA makes the unjustified assumption that atrazine's only relevant mode of action is attenuation of the luteinizing hormone surge. In fact, studies have demonstrated that atrazine disrupts hormonal function in vertebrates via eight different mechanisms, only one of which is considered by EPA (e.g. Hayes et al. 2011, Figure 4, Section 1.5). EPA's scientific advisors have also pushed back against the Agency's

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<sup>74</sup> FQPA prescribes a default 10x safety factor as described above; it can be increased or reduced, with reduction to 1x equivalent to eliminating it.

fixation on this one mode of toxic action as the only relevant one. For instance, SAP (2011) noted that EPA focused almost exclusively on the neuroendocrine pathway and suppression of the LH surge, but that research is needed into other mechanisms, particularly those relevant to atrazine's carcinogenic potential (SAP 2011, p. 67). In short, EPA does not have "reliable data" to rule out toxic effects via mechanisms it does not consider. Finally, the FQPA safety factor is not equivalent to a database uncertainty factor, despite EPA's ongoing efforts to conflate the two (EPA 2002b, p. 4-44 to 4-45). The FQPA safety factor is statutorily prescribed for protection of infants and children, and as noted above, EPA policy demands its application in cases of increased susceptibility or sensitivity of young, a threshold that is clearly met in the case of atrazine.

### *iii. Cancer*

Atrazine exposure has been associated with increased risk of several cancers in various studies. In an integrative assessment of three studies encompassing farmers in Nebraska, Kansas, Iowa and Minnesota, De Roos et al. (2003) found farmers exposed to atrazine had a 60% higher incidence of non-Hodgkin lymphoma (NHL), with an odds ratio of 1.6 (logistic regression). The study involved a large number (650) of NHL cases, strengthening confidence in the statistically significant results. Schroeder et al. (2001) found elevated levels of a particular genetic subtype of NHL in a subset of the atrazine-exposed farmers in the De Roos et al. (2003) study.<sup>75</sup> MacLennan et al. (2003) found that triazine manufacturing plant workers in Louisiana had a nearly four-fold higher mortality rate from NHL than the general population of Louisiana's industrial corridor, although the number of cases was small.

Another study of the same Louisiana triazine plant workers identified a six-fold higher than expected incidence of prostate cancer, again in comparison to the general population of Louisiana's industrial corridor. When the comparison is made to Louisiana-wide cancer rates instead, the triazine plant workers had an enormous nine-fold higher than expected incidence of prostate cancer over the full 1985-1999 monitoring period (MacLennan et al. 2002, Sass 2003). The plant in question belonged to Novartis (acquired by Syngenta), and the study of plant workers was funded via a grant by Novartis to the scientists' employers, the University of Alabama at Birmingham (Sass 2003). MacLennan et al. (2002) attribute the higher than expected prostate cancer incidence among its actively working employees to increased detection in the context of the plant medical department's prostate specific antigen (PSA) screening program. EPA endorses this view, but the Scientific Advisory Panel charged by EPA with assessing the matter did not. In fact, EPA blatantly mischaracterizes the SAP's views on this matter, claiming that the "SAP concurred with EPA's conclusion that an increase in prostate-specific antigen (PSA) screening could explain the observed increase in prostate cancer incidence in workers" (EPA PIRRD 2019, pp. 21, 60). In fact, the SAP stated: "Given the limitations in both the study design and the analysis of the cohort study, at this time a role for atrazine as a potential cause of prostate cancer cannot be considered unlikely" (SAP 2003, p. 12). Likewise, many other scientists who reviewed the matter found that while cancer detections via PSA screening accounted for some of the excess cases, atrazine exposure likely also explained some portion of the triazine workers' prostate cancers (Sass et al. 2003).

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<sup>75</sup> The t(14;18) translocation; the subset included Iowa and Minnesota farmers.

The epidemiology finds support in animal experiments. Rat pups exposed to atrazine via mothers' milk during the first four days of life develop prostatitis (aka inflammation of the prostate, which disrupts its function) later in life (EPA 7/10/18, pp. 28, 34, citing Stoker et al. 1999). In humans, inflammation of the prostate "is the most tightly correlated histological anomaly to prostate cancer," and is thought by many prostate biologists to induce or promote this cancer (SAP 2011, pp. 46, 48).

Finally, there is also mechanistic data that supports both the human and animal findings. In experiments on an RM1 prostate cancer cell line, and on an RM1 cell xenograft mouse model, Hu et al. (2016) found that atrazine enhanced the proliferation, migration and invasion of RM1 cells. Their conclusion: "These effects promote [prostate] tumor malignancy. Therefore, prostate cancer patients should stay away from atrazine, and farmers should be regularly screened for prostate cancer."

In view of this evidence for these two cancers alone, EPA's classification of atrazine as "not likely to be carcinogenic to humans" is insupportable. This was also the conclusion of the SAP referenced above, which, after reviewing atrazine cancer epidemiology as a whole, took strong exception to EPA's statement that: "the weight of the evidence supports that atrazine is not likely to be carcinogenic in the human population" on several counts. The SAP found that EPA had not conducted a "weight of the evidence" assessment at all, but merely used the toxicological evidence "to nullify any positive evidence from epidemiology studies," among other objections (SAP 2011, p. 57). The SAP's conclusions on atrazine were as follows (Ibid., p. 64):

Suggestive evidence of carcinogenic potential for:

- \* Ovarian cancer, non-Hodgkin lymphoma, hairy-cell leukemia and thyroid cancer.

Inadequate information to assess carcinogenic potential for:

- \* Prostate cancer, breast cancer, liver cancer, esophageal cancers, and childhood cancers.

While the SAP judged atrazine as not likely to cause a number of other cancers, the existence of suggestive evidence for *any* cancer obviously disallows the "not likely to be carcinogenic to humans" designation. This descriptor that EPA assigned not only ignores the informed views of its scientific advisors, it also directly and blatantly contradicts the Agency's own Guidelines for Carcinogen Risk Assessment, which prescribe the "not likely" descriptor only "when the available data are considered **robust for deciding that here is no basis for human hazard concern**" (EPA 2005, 2-57, emphasis added). That is clearly not the case with atrazine. Based on EPA Guidelines, atrazine should be classified as "likely to be carcinogenic to humans" because the evidence for its association with prostate cancer fits the following criteria for that designation:

"[A]n agent demonstrating a plausible (but not definitively causal) association between human exposure and cancer, in most cases with some supporting biological, experimental evidence, though not necessarily carcinogenicity data from animal experiments." (EPA 2005, pp. 2-54 to 2-55)



C. Occupational exposure: EPA’s risk mitigation measures for occupational workers are inadequate and will not result in “no unreasonable adverse effects.”

Regardless of EPA’s implementation of risk mitigation measures for occupational workers, the costs from exposure to atrazine outweigh the benefits of its continued use. EPA presents seven scenarios for occupational use of atrazine “for which potential occupational risks of concern remain (i.e. MOEs remain below the LOC of 30) assuming the highest possible level of PPE and/or engineering controls” (EPA PIRRD 2019, pp. 14-15 for following).

- 1) Mixing and loading dry flowable/water dispersible granule formulations for aerial application to sorghum and conservation reserve program areas (MOE = 15 with engineering controls);
- 2) Mixing and loading liquid formulations for impregnated dry bulk fertilizer application (MOE = 21 with engineering controls) to corn, sorghum, sod, and bioenergy crops;
- 3) Mixing and loading water soluble packets for aerial application to guava (MOE = 26 with engineering controls), sod (MOE = 26 with engineering controls), corn, sorghum, winter weeds, conservation reserve program areas (MOEs = 15 with engineering controls), fallow areas (MOE = 14 with engineering controls), and sugarcane (MOE = 7.7 with engineering controls);
- 4) Applying sprays via mechanically pressurized handguns to roadsides (MOE = 7.4 with double layer, gloves and particulate filtering facepiece respirator (PF 10 respirator); EC not applicable);
- 5) Mixing, loading and applying dry flowable/water dispersible granule, liquid formulations to landscape turf (MOE = 23 with double layer, gloves and PF 10 respirator; EC not applicable) using backpack spray equipment;
- 6) Mixing, loading and applying dry flowable/water dispersible granule, liquid and water soluble packets formulations using mechanically pressurized handguns to macadamia nuts (MOE = 3.8 with double layer, gloves and PF 10; EC not applicable), sweet corn (MOE = 7.4 with double layer, gloves and PF 10 respirator; EC not applicable), and guava (MOE = 7.4 with double layer, gloves and PF 10 respirator; EC not applicable);
- 7) Loading and making broadcast applications of dry flowable/water dispersible granule and liquid formulations to roadsides using backpack spray equipment (MOE = 15 with double layer, gloves and particulate filtering facepiece respirator (PF10); EC not applicable).

While EPA proposes mitigations for these atrazine use scenarios (EPA PIRRD, pp. 27-28), the Agency concedes that they are not sufficient, even if perfectly followed, to mitigate the health risks to occupational users.

“In evaluating potential risk mitigation for atrazine, the EPA considered the risks, the benefits, and the use pattern. Although there are potential risks of concern associated with

the use of atrazine, with the adoption of the mitigation measures discussed in this section, *any remaining potential worker and/or ecological risks are outweighed by the benefits associated with use of atrazine*” (EPA PIRRD 2019, p. 28, emphasis added)

EPA cannot offset human health risks by reference to putative “benefits” of atrazine’s use; human health is not subject to the cost-benefit calculus EPA applies to ecological risks. In any case, the health harms to occupational users will be greater than EPA estimates, since it is well-known that mitigation measures – such as wearing personal protection equipment (PPE) – are often not followed (Jacobs and Clapp 2008). The putative benefits are also wildly exaggerated, as discussed below. Finally, EPA’s section on expected impacts of the proposed mitigation is almost entirely devoted to demonstrating that the proposed mitigation measures will leave current atrazine use practices almost entirely intact, with little need for adaptation (EPA PIRRD, pp. 35-46). There is no assessment of the adoption rate, feasibility or efficacy of the PPE or other measures proposed to ameliorate harms to human health.

It is clear from the evidence that these seven use scenarios for occupational workers exceed risk concerns even when the maximum available personal protective equipment and/or engineering controls (proposed mitigation measures) are used. Thus, EPA has not done a thorough cost-benefit analysis and therefore cannot support a “no unreasonable adverse effect” determination as required under FIFRA.

## **VIII. Environmental Risks of Atrazine Use**

EPA’s 2016 ecological assessment makes it clear that all major classes of organisms are threatened by atrazine use: birds, mammals, amphibians, fish, and both terrestrial and aquatic plants. This is true both when maximum labeled rates are used, and in many scenarios even with reduced rates of 0.5 or 0.25 lbs/acre.

Atrazine runoff and spray drift imperil a broad range of plant species at distances up to 600 feet from the edge of a sprayed field. The risks of long-term exposure to atrazine exceed EPA’s levels of concern by up to 22 and 198 times for birds and mammals, respectively. As for terrestrial invertebrates, atrazine is toxic at low application rates to springtails (EPA 4/12/16, pp. 28, 158), which are extremely important decomposers, and abundant invertebrates at the bottom of terrestrial food webs. Atrazine thus threatens the nutrient recycling capacity of agroecosystems and natural habitats, as well as the higher organisms that depend upon them.

Risks to aquatic organisms and communities are even greater, given the persistence of atrazine and its metabolites in water, and the exquisite sensitivity of aquatic plants and animals to atrazine’s effects.

Below we address two critical aspects of EPA’s ecological risk assessment: the concentration-equivalent level of concern (CE-LOC) for aquatic plant communities; and the chronic endpoint for fish and aquatic-phase amphibians. Otherwise, we endorse and incorporate by reference the comments submitted to this docket by the Center for Biological Diversity.

### **A. Aquatic Plant Communities**

In the 2016 draft ecological risk assessment, EPA proposed to lower atrazine's current concentration equivalent level of concern (CE-LOC) for aquatic plant communities from 10 ppb to 3.4 ppb. EPA concluded that "when considering the question 'is the CELOC at 3.4 ug/L protective given the body available evidence?', the EPA determined that, based on the preponderance of evidence, the CELOC is protective of amphibians and represents a reasonable quantitative threshold for evaluating risk to amphibians."<sup>76</sup> Contrary to past findings and without any reasoned explanation, EPA has now proposed to raise the CE-LOC to 15 ppb, nearly a 5-fold increase over what the agency determined was necessary to protect aquatic organisms in 2016.

Atrazine is highly toxic to aquatic plants. An atrazine concentration of just 1 part per billion (ppb) reduces chlorophyll production by 67% and 93% in chlorophycean "green" algae and cyanobacterium "blue-green" algae, respectively, while other species of non-vascular as well as vascular aquatic plants are also sensitive to low ppb concentrations of atrazine (EPA PIRRD, p. 31).

Aquatic plant communities are the foundation upon which aquatic life depends. Therefore, EPA evaluated the risk posed by atrazine to the structure and function of freshwater aquatic plant communities, with the goal of ensuring the plant community's productivity is maintained so as to prevent endangerment of the aquatic ecosystem, including the fish, amphibians, invertebrates and other organisms that depend on the plant community.

To this end, EPA evaluated not only experiments to determine the sensitivity of individual species to atrazine, but also more realistic microcosm and mecosm (collectively "cosm") studies involving multiple species. Based on this evaluation, EPA developed a concentration-equivalent level of concern (CE-LOC) that represented the Agency's best estimate of the maximum concentration of atrazine consistent with maintaining aquatic plant communities in reasonable health. The current CE-LOC is 10 ug/liter or 10 ppb.

EPA has adjusted the CE-LOC over the past 15 years in response to new studies (especially cosm studies) and recommendations of at least three different Scientific Advisory Panels (EPA 4/12/16, Section 10.4). EPA's latest assessment indicated a need to lower the CE-LOC to 3.4 ug/liter, a level that still poses risks. EPA determined that "... a 60-day average of 3.4 ug/liter has a high probability of impacting aquatic plant community primary productivity, structure and function" (EPA 4/12/16, p. 2). However, rather than lower the CE-LOC from 10 to 3.4 ug/liter to ameliorate at least the worst harms, EPA has instead proposed to arbitrarily raise it to 15 ug/liter, virtually ensuring substantial degradation of aquatic plant communities and ecosystems from atrazine use. EPA provides no scientific rationale for this change, aside from unconvincing suggestions that aquatic plant communities may recover from exposures to lower atrazine concentrations, and reference to the putative, wildly exaggerated "benefits" of atrazine (EPA 10/22/19).

The real instigation for this nearly five-fold increase in the atrazine CE-LOC level (from 3.4 to 15 ug/liter) is purely political. In a September 2016 meeting between Syngenta officers and EPA, a prime topic of discussion was "registrant concerns related to EPA's review of cosm

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<sup>76</sup> EPA, *Refined Ecological Risk Assessment for Atrazine*, at 311 (2016).

studies used to derive the concentration equivalent level of concern (CELOC)...” (EPA-Syngenta 9/22/16; see also EPA-Syngenta 9/26/19). Those discussions have borne fruit for Syngenta, in that it succeeded in having EPA management throw out over a decade of scientific work by EPA scientists and the advice of its advisors, and raise allowable atrazine levels in water bodies by nearly five-fold. Because even 3.4 ug/l has a “high probability” of negatively impacting aquatic plant communities, a CE-LOC of 15 ug/l would undoubtedly cause substantial damage.

EPA presents no scientific rationale for this dramatic increase. Rather, the agency continues to overlook its very own scientists’ judgement about the effects of atrazine on aquatic organisms to satisfy industry interests.

#### B. Chronic endpoint for fish and aquatic-phase amphibians

EPA has rightly been criticized by ecotoxicologists with a long history of experimentation on the threats posed by atrazine to fish and aquatic-phase amphibians. Boone et al. (2014) make the stunning point that in EPA’s 2007 and 2012 assessments of atrazine, the Agency excluded from quantitative assessment 74 of 75 published laboratory studies on the effects of atrazine on amphibians. The single study it relied upon (Kloas et al. 2009) was an outlier, finding virtually no adverse reproductive impacts even at relatively high doses of atrazine; was funded by Syngenta, chief registrant of atrazine; and has as one co-author an employee of Syngenta.

Similarly, EPA’s 2016 ecological risk assessment repeatedly cites a second Syngenta-funded review of atrazine’s effects on aquatic organisms by well-known pesticide industry consultant Keith Solomon and colleagues (Solomon et al. 2008), despite the fact that a critique of this oft-cited review paper by independent scientists found that it misrepresented over 50 of the studies it reviewed, and had 122 inaccurate and 22 misleading statements, with 96.5% of the 144 inaccurate/misleading statements beneficial to the interests of Syngenta (Rohr and McCoy 2010a, b). Not surprisingly, EPA takes no notice of either Boone et al. (2014) or Rohr and McCoy (2010a, b).

In the 2016 ecological assessment, EPA decided that atrazine did pose a “possible risk” of multiple adverse effects to amphibians at estimated environmental concentrations, but failed to undertake a quantitative estimate of risk.

“The weight of evidence analysis concluded there is possible risk to amphibians as there is significant overlap of multiple effects endpoints and the EECs estimated with modeling, as well as surface water monitoring results. This is consistent with the results found for all other aquatic organisms, including fish, invertebrates and plants. Due to the variability in the reported amphibian endpoints, establishment of a definitive quantitative value for RQ calculations was not possible. **Instead, chronic endpoints for fish and plants are considered acceptable surrogates for protection of aquatic amphibian species.**” (EPA 4/12/16, p. 31, emphasis added)

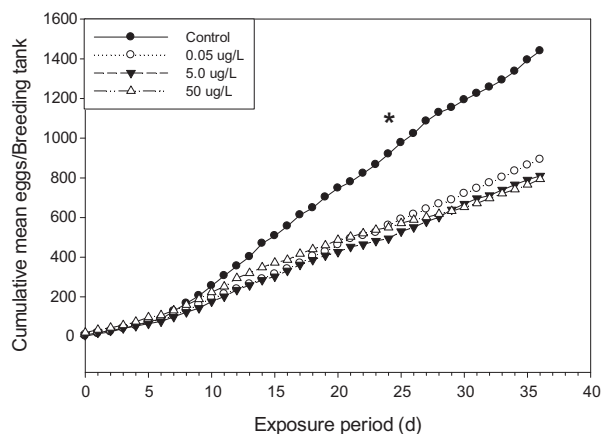
EPA’s failure to calculate a risk estimate is highly unusual. The stated reason – “variability in the reported amphibian endpoints” – is inadequate, since EPA’s risk assessment

process is explicitly based upon utilizing the most sensitive endpoint for establishment of safety thresholds. The literature on atrazine's adverse effects on fish and amphibians is huge, and includes findings of sublethal effects at low doses, including effects on amphibian metamorphosis, impairment of antipredator behavior, reduced olfactory abilities in fish, impairment of immune function with increased susceptibility to pathogens, and alterations in gonadal morphology and function, among other effects (Rohr and McCoy 2010b)

It is hard to avoid the conclusion that EPA has fallen victim to Syngenta's aggressive "atrazine defense" campaign, which as noted above has involved ample funding of scientists to conduct studies and reviews aimed at discounting the adverse effects of atrazine on amphibians in particular. It has also involved an expansive "dirty tricks" campaign intended to destroy the reputation of one prominent researcher in the field, Tyrone Hayes (Howard 2013). EPA is urged to read the Howard (2013) article as well as the peer-reviewed account of the tricks used by industry- and industry-funded scientists to misrepresent atrazine's toxicity (Hayes 2004).

EPA did at least utilize an independent study in its assessment of atrazine's chronic risk to fish. A team composed mainly of U.S. Geological Survey scientists determined that Japanese medaka fish exposed to low levels of atrazine for just 38 days experienced sharp declines in cumulative egg production (Papoulias et al. 2014). The reductions were statistically significant and striking, ranging from 36% to 42% for the three atrazine concentrations tested: 0.5 ug/l, 5.0 ug/l and 50 ug/l, equivalent to 0.5, 5 and 50 ppb (see figure below). This study is supported by quite similar results – declines in cumulative egg production – in fathead minnows using a very similar experimental protocol and the same exposure concentrations (Tillitt et al. 2010).

Rather than adopting 0.5 ppb as the chronic threshold for fish impairment, however, as the results clearly demanded, EPA re-analyzed the data according to a different set of guidelines and somehow succeeded in torturing those data such that a dose triggering more than a one-third reduction in cumulative egg production over 38 days (0.5 ppb, 36% reduction) became a "no effect" dose; not only that, the 10-fold higher mid-dose of 5 ppb also became a no effect dose, the NOAEC. Only the high dose of 50 ppb was regarded as causing an effect (EPA 4/12/16, p. 162).



**Fig. 1.** Mean cumulative egg production (number/tank) of medaka exposed to atrazine. Cumulative egg counts were compared with SAS Statistical Software GLM procedure and least square means ( $p = 0.05$ ). The first day in which cumulative egg numbers were significantly different from controls is designated with an asterisk.

Source: Papoulias et al. (2014).

Thus, even when EPA takes the nearly unprecedented step of utilizing an independent rather than registrant-submitted study for quantitative assessment of a toxicity threshold, the study is re-interpreted out of all resemblance to its true findings to justify substantially higher levels of contamination.

## IX. Risks, Costs, and Mitigation

FIFRA requires that pesticides be registered only if they do not cause “unreasonable adverse effects on the environment,” which includes “any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide.”<sup>77</sup>

EPA has failed to provide anything close to a full and objective accounting of the risks and economic, social and environmental costs of atrazine use. EPA acknowledges environmental risks of atrazine use, but fails to provide any demonstration that its proposed mitigation measures would actually mitigate those risks. The proposed mitigation measures are insufficient and will not result in “no unreasonable adverse effects” of the PIRRD.

The agency has proposed a mere rate reduction for a minor use of atrazine on turf, some additional PPE requirements of which compliance is uncertain, and “drift reduction” measures that appear to be boilerplate measures that the agency continues to use for most pesticides under registration review at the moment.<sup>78</sup> Such measures are already common practice and include boom height restrictions, wind speed restrictions, and droplet size restrictions.

<sup>77</sup> 7 U.S.C. §§ 136a(c)(5)(C); 136(bb).

<sup>78</sup> See PIRRD, at 27-46 (Section IV).

While EPA has proposed a few increased safeguards, it has also proposed significant decreases in current safeguards. This includes proposing to increase the allowable wind speed for aerial applications of atrazine from the current 10 mph cutoff to a more lenient 15mph cutoff, as well as proposing to raise the CELOC from 10 ppb to 15 ppb, which is an actionable level requiring mitigation measures to be taken by atrazine manufactures. EPA has proposed increasing and decreasing these safeguards without providing any evidence showing how these measures will affect human health and the environment.

EPA has not accounted for the many social, economic and environmental costs of atrazine use, and therefore cannot lawfully issue a final registration review decision pursuant to FIFRA, FFDCA, and ESA.

## **X. Putative Benefits of Atrazine Use**

EPA presents outlandishly high estimates of “benefits” provided by atrazine in terms of preventing yield reductions from weed competition, as well as increased costs on replacement herbicides if atrazine were not available. EPA leans on “great benefits” to justify sacrificing aquatic organisms by raising allowable aquatic concentrations of atrazine of up to 15 ppb, approximately a 5-fold increase over what the agency determined was necessary to protect aquatic organisms in 2016, a CELOC of 3.4 ppb.

EPA’s benefits assessment is fundamentally flawed. First and most basically, it should by law encompass both costs and benefits of the proposed decision. EPA’s exclusive focus on putative benefits ignores, for instance, the massive costs that have already been borne by local governments and water utilities to remove atrazine from drinking water supplies. It took a class action lawsuit against Syngenta by 16 Midwestern cities to achieve some defrayal of the funds they expended to reduce atrazine levels in their water supplies (Duhigg 2009, Walton 2012). With EPA’s proposed renewal of atrazine’s registration with only minor mitigations, it is likely many hundreds of millions to billions of dollars will be spent by other communities seeking to keep this hazardous endocrine disruptor out of their drinking water. EPA ascribes zero costs on this count, which itself renders the benefits assessment and proposed decision invalid.

As regards supposed benefits from weed control to farmers, EPA’s assessment is economically naïve, and ignores many viable alternatives. First, while EPA claims to base its assessment on economic theory (EPA 11/25/1, p. 9), the Agency’s economists apparently do not understand even the basic economic law of supply and demand. Ackerman et al. (2014) have shown that, even if one accepts the premise of corn yield reduction if farmers do not have access to atrazine, the decreased corn supplies would raise corn prices such that corn farmers would enjoy an overall increase in revenue amounting to \$1.7 billion. In addition, EPA’s estimates of the cost of alternatives to atrazine are highly questionable, given the huge array of available corn herbicides, and they underestimate the ingenuity of farmers in altering their weed management programs to adjust. While many have claimed atrazine is needed to address weed resistance to other herbicides, this is a short-term fool’s argument in a world in which weeds are rapidly evolving resistant to multiple herbicides. One claim in particular – that atrazine is needed to address glyphosate-resistant weeds – is ludicrous on its face. The fact of the matter is that glyphosate-resistant weeds have spread to infest an estimate 120 million acres of American

cropland (Pucci 2018) during a period of time of massive and steady use of atrazine at annual amounts of 65 to over 80 million lbs. If atrazine really were somehow a “weed resistance management tool,” it must be an extremely poor one, have entirely failed to staunch or even slow the greatest weed resistance challenge farmers have ever faced. And it should also be noted that atrazine resistance is prevalent in a large number of weeds across millions of acres of U.S. cropland. EPA should ascribe a cost to the increased herbicide use farmers have resorted to in an effort to respond to and manage atrazine-resistant weeds.

Ending the registration of atrazine would have the beneficial effect of stimulating application of integrated weed management (IWM) practices that save farmers money, reduce overall use of weed-killing pesticides as well as the epidemic resistant weeds they give rise to, and promote both ecological and human health (Mortensen et al. 2012, Ackerman et al. 2014).

In conclusion, EPA has not conducted an adequate cost-benefit analysis and therefore is unable to support a finding of “no unreasonable effect.” Such a determination would violate FIFRA, and thus, EPA cannot move forward with the current PIRRD without violating federal pesticide law.

## **XI. Conclusion**

Center for Food Safety urges EPA to cancel the registration of atrazine rather than renew it. This potent, endocrine-disrupting herbicide poses far too many risks to human health and the environment to justify its continued use.

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