

“What You Should Know About Atrazine,”
Tyrone Hayes’ website

Document Excerpt #1

What is Atrazine? And why do we love it?

Atrazine is an herbicide (weed killer) primarily used on corn. Atrazine is the most common chemical contaminant of ground and surface water in the United States. It is a potent endocrine disruptor with ill effects in wildlife, laboratory animals and humans. Atrazine chemically castrates and feminizes wildlife and reduces immune function in both wildlife and laboratory rodents. Atrazine induces breast and prostate cancer, retards mammary development, and induces abortion in laboratory rodents. Studies in human populations and cell and tissue studies suggest that atrazine poses similar threats to humans. The peer-reviewed scientific studies to support these statements are summarized and can be viewed as you navigate this web site.

Atrazine has been denied regulatory approval by the European Union and is, thus, banned in Europe and even in Switzerland, the home of the manufacturer. Despite the environmental and public health risks, atrazine continues to be used in the US, for economic reasons. Atrazine may only increase corn yield by as little as 1.2 % (and not at all according to some studies). The agri-giant Syngenta, however, has a very powerful lobby and spent \$250,000 lobbying in Minnesota alone in 2005 to keep atrazine on the market there. With as little as 1.2 % increase in corn, a crop that we consume less than 2% of, in a world where 20% of the population will die of starvation, it is incumbent upon us to become involved in the regulatory process regarding atrazine. We (the public) must play an active role in this regulatory decision.

Atrazine has detrimental ecological impacts on plants and wildlife

After 49 years of using atrazine at or above 80 million pounds per year, many target weed species have become atrazine-resistant [1, 2]. In fact, the number of documented atrazine-resistant “super” weeds number more than 80. No other herbicide has produced such dramatic effects on the evolution of weeds.

In addition to the ecological impacts on land, recently, the National Oceanic and Atmospheric Administration (NOAA), showed that atrazine negatively affects marine phytoplankton [3, 4]. These microscopic organisms serve as food for other organisms such as clams and oysters and the effect of atrazine is likely reflected throughout marine food webs: Phytoplankton serves as food for zooplankton which is in turn food for many larval and young fish and several species of whales. Thus, atrazine’s impact on this critical member of the marine food web will have dramatic and irreversible effects on marine life including damage to commercially important shellfish and finfish populations as well as sea mammals (whales) of which many are already threatened or endangered.

Similarly, atrazine negatively affects freshwater aquatic habitats. Several studies have shown that atrazine decreases algae and other aquatic plant life [5-7]. This plant life serves as food for microorganisms and invertebrates that in turn serve as food for other organisms up the food web including fish. Further, algae, and other aquatic plants serve directly as food for larval frogs (tadpoles) and atrazine will negatively affect important sentinel species of amphibians, many of which are already declining, endangered, or threatened.

Atrazine is an endocrine disruptor that causes abnormal reproductive development and immune suppression in wildlife

Endocrinology is the study of hormones. Hormones (endocrine substances) control growth, reproduction, metabolism, development, behavior, immune function, and stress, among other functions critical for life. Hormones are also important in many disease states including diabetes and cancer. Endocrine disruptors, such as atrazine, which interfere with hormone production and/or activity, can affect any of these processes

In particular, atrazine inhibits production of testosterone (the male sex hormone) and induces estrogen production (the female sex hormone), upsetting the balance between these two hormones. This effect of atrazine has been observed and published in fish [1, 2], amphibians [3, 4], reptiles [5, 6], and mammals [7-14]. The result is chemical castration (de-masculinization) and feminization. In fish [1, 2], amphibians [3, 4, 15-20], and laboratory rodents [7, 8, 10], the decrease in testosterone results in decreased sperm counts, impaired fertility, and a reduction in masculine features. Similarly, atrazine exposure is associated with decreased sperm and reduced fertility in humans [21]. The increase in estrogen by atrazine results in feminization of males in fish, amphibians, and reptiles. "Feminized" male fish [2] and amphibians produce eggs and egg yolk [16, 18]

In laboratory rodents, atrazine-induced estrogen production and causes reproductive cancers (prostate cancer in males [22, 23] and breast cancer in females [22, 24]) to develop. In fact, female rats exposed to atrazine, will produce male offspring with prostate disease, if dams (mothers) are exposed while pregnant or suckling [23]. Atrazine also causes immune system failure in animals. This effect has been shown in amphibians and laboratory rodents. In amphibians, atrazine exposure impairs immune function and increases susceptibility to disease [25-29].

Immune cells are unable to eliminate disease pathogens [28] and exposed amphibians are more likely to succumb to viral diseases [25, 26], bacterial infections [27] and macroparasites [30, 31], including the parasites that cause limb deformities in amphibians [29]. Similarly, atrazine exposure in rodents impairs immune function [32-40] and decreases an exposed animal's ability to fight cancer [33] and other diseases. Further, atrazine exposure in rodents can lead to hypersensitivity [36], making exposed animals more susceptible to allergies. Most likely, the negative effects on immune function are due to an atrazine-induced increase in the stress hormones (corticoids). In salmon, the atrazine-induced increase in stress hormones in fresh water smolt, impairs the ability of exposed fish to return to the ocean leading to high mortality in these commercially important fish [41].

Atrazine is a threat to several endangered species

Given the many detrimental effects on wildlife and laboratory animals, the large number of studies from so many independent laboratories, and the associated effects in humans, it is not likely that the observed effects are mistakes, misinterpretations, or artifacts. In particular, given atrazine's solubility in water, aquatic animals such as fish and amphibians are at the greatest risk. Salmon and trout which are commercially important are at risk as are the economies that depend on healthy fish. Several salmon and trout species are already endangered or threatened as are other fish. Amphibians are also very sensitive to endocrine disruptors and given that already more than 60% of all amphibians are in decline and a third are threatened or endangered, atrazine is of great concern and several studies suggest that pesticides (including atrazine) may be an important factor in declines [1-7]. Atrazine has already been banned as a result of lawsuits to protect two endangered amphibians and similar cases are developing for endangered fish.

"What you should know about atrazine."
AtrazineLovers. 29 Feb 2008.
<<http://www.atrazinelovers.com/>>

“Atrazine Litigation Facts”

Syngenta Web site

Document Excerpt #2

In July and August of 2004, law firms based in Missouri and Texas filed a series of class action complaints in Madison County, Illinois, on behalf of the Holiday Shores Sanitary District, a local water utility.

These are identical “cookie cutter” suits filed against Syngenta and five other corporations that manufacture, formulate or market products containing atrazine. Growmark, a distributor of agricultural products located in Madison County, is named co-defendant in all the lawsuits—providing a basis for the suits to be brought in the county called a “judicial hellhole” by the American Tort Reform Association.

The lawsuits make a series of false allegations about atrazine, using a handful of questionable studies to justify claims that the EPA standard for atrazine in drinking water (three parts per billion) is not protective of human health. The suits seek class-action remedies and a wide variety of financial penalties including payment for the charcoal water filtering system that Holiday Shores Sanitary District has had in operation for more than a decade. Yet, Holiday Shores certifies to both the state and federal EPAs—and its customers—that its drinking water meets the stringent safety standards of these agencies.

So, Holiday Shores Sanitary District supplies residents with drinking water that meets strict federal and state safety standards. At the same time, the District is suing atrazine manufacturers on the basis that the water is unsafe, even as it continues to sell the water to its customers. Summed up, Holiday Shores Sanitary District is asking for a quality of water it acknowledges it already has.

This lawsuit flies in the face of good regulatory policy, good science and good common sense.

Regulatory policy: The US Environmental Protection Agency is responsible for evaluating possible human health and environmental effects of pesticides, and for setting and enforcing standards to guide their use. In the case of atrazine, EPA has just completed a comprehensive, science-based, 10-year safety review and recommended its continued use in agriculture.

One of the standards set by EPA is for the presence of a substance in drinking water, called a Maximum Contamination Level (MCL). EPA has set an MCL for atrazine of three parts per billion (ppb). In an abundance of caution, this MCL has a 1,000 fold safety factor—in other words, the standard is set 1,000 times higher than a level found to produce no negative effects in laboratory studies. This means that a 150-pound adult could drink 21,000 gallons of water with three ppb of atrazine a day for 70 years and still not get enough atrazine to cause adverse health effects.

State EPAs can adopt this very conservative federal EPA standard or set tougher standards of their own. Illinois and 48 other states have adopted the federal MCL for atrazine (only the state of California chose a different standard).

The Holiday Shores lawsuit ignores the long-standing drinking water standard for atrazine and makes broad, unsubstantiated health claims linked to any detectible level of the herbicide. If a jury awards damages in this case, it will set a precedent for financially-driven, local litigation to override the science-based judgment of EPA—and indeed any regulatory agency in the US.

Science: In support of its counts, the lawsuit relies upon scientific research which has not passed the litmus test of sound science: the ability to repeat results with scientific and statistical confidence. It

frequently cites a 2002 study by Dr. Tyrone Hayes that claims atrazine affects the sexual development of frogs. But in fact, EPA, in a public address to the Minnesota Legislature in February 2005, said “Dr. Hayes claims not only has his laboratory repeated his findings many times in his experiments with thousands of frogs, but that other scientists have also replicated his results. EPA, however, has never seen either the results from any independent investigator published in peer-reviewed scientific journals, or the raw data from Dr. Hayes’ additional experiments that confirm Dr. Hayes’ conclusions.”

Further, a special Scientific Advisory Panel convened by EPA concluded “there are currently insufficient data” to confirm the theory that atrazine exposure may impact frog development.

The frog studies are only a few grains of the mountain of atrazine studies EPA says it has on file: nearly 6,000. Many of these examine atrazine and its potential to cause cancer. On this issue, EPA has clearly stated atrazine is “not likely” to cause cancer (the most favorable category). The World Health Organization and the National Cancer Institute have also examined the issue and found no cancer concerns.

Common sense: Atrazine has been used safely by farmers for more than 45 years. It is the most popular corn herbicide in the U.S. and is registered for use in more than 80 countries around the world.

Atrazine helps prevent the number one EPA-ranked cause of pollution in our nation’s waterways: runoff of sediment. It does so as a vital tool in conservation tillage, a farming method used in Madison County and throughout Illinois to reduce soil erosion.

U.S. farmers prefer atrazine over other herbicides because it works better and costs less. Now found in more than 45 pre-mixes in the U.S., atrazine is the active ingredient most frequently used by manufacturers in combination herbicide products. EPA has estimated that atrazine offers U.S. corn farmers a \$28-per-acre advantage over other herbicides due to cost and yield benefits.

The bottom line: We should allow the qualified scientists at EPA—not lawyers seeking financial gain through scare tactics—to determine the regulation of agricultural products, including atrazine.

“Atrazine Litigation Facts.” Syngenta 2006. 29 Feb 2008. < <http://www.atrazinefacts.com/litigation-3.asp?v=p> >

“Studies Conflict on Common Herbicide Effects...”

Carol Kaesuk Yoon, *New York Times*

Document Excerpt #3

Despite the release of a flurry of new results in what is becoming an increasingly intense debate, scientists still have not reached a consensus as to whether the nation's most commonly used herbicide is harming amphibians in the wild. The new studies raise questions about whether atrazine, used primarily for killing weeds in cornfields, is acting as an endocrine disrupter in amphibians, interfering with normal hormonal functions, and causing males to become hermaphrodites, producing eggs in their testes. Some 60 million to 70 million pounds of atrazine are applied each year in the United States, and it has been found in rivers, ponds, snowmelt and rainwater.

Scientists have taken a particular interest in the new studies because such a widespread endocrine disrupter could help explain worldwide declines of amphibians. The studies could also affect continued use of atrazine. The Environmental Protection Agency is reviewing the herbicide's environmental risks as part of the periodic reregistration process required for continued sale of such chemicals. Much of the newest research was presented yesterday at the Society of Environmental Toxicology and Chemistry in Salt Lake City.

The controversy began in April when Dr. Tyrone Hayes, an endocrinologist at the University of California at Berkeley, and colleagues published results in *The Proceedings of the National Academy of Sciences* indicating that very low concentrations of atrazine, similar to those seen in the wild, could turn males of the African clawed frog into hermaphrodites in the laboratory. Then last month in *Nature*, Dr. Hayes and colleagues published studies showing that males of the leopard frog, a native species, could also be feminized by exposure to low levels of atrazine in the laboratory. More worrisome, the researchers found that in the seven field sites from Utah to Iowa where they could detect atrazine, they also found hermaphroditic frogs. At the one site without detectable atrazine, there were no hermaphrodites.

Two industry-sponsored studies, carried out by a team that has been critical of Dr. Hayes's work, have failed to replicate the findings with the clawed frog. The work was paid for by Syngenta, a maker of atrazine. Yesterday the team also reported that it had examined wild-caught males of the clawed frog where it is native in Africa and where atrazine is widely used and found no hermaphrodites. “Validated information should be replicable,” said Dr. Ronald Kendall, an environmental toxicologist at Texas Tech University and a wild-caught males of the clawed frog where it is native in Africa and where atrazine is widely used and found no hermaphrodites. “Validated information should be replicable,” said Dr. Ronald Kendall, an environmental toxicologist at Texas Tech University and a leader of the industry-sponsored team.

Dr. Hayes said he was surprised by the high levels of hermaphroditism caused by sometimes minute levels of atrazine, with sometimes as many as one-third of the males affected. The effects were less severe at higher levels of the herbicide. But while that might seem counterintuitive, Dr. Hayes said it was typical for chemicals affecting hormones to have highly different, even opposite effects at increased levels.

Dr. Kendall said his team's work had been wrongly impugned as biased because of its industry financing, and he pointed out that Dr. Hayes also formerly received Syngenta financing. Dr. Hayes said his original research showing that atrazine could create hermaphroditic frogs was sponsored by Syngenta, which never published the work. The April publication in which he replicated that research was sponsored by the National Science Foundation; the *Nature* study was paid for by the W. Alton Jones Foundation, which finances environmental work, and the conservation group WWF. It remains unclear why the studies conflict.

Dr. Hayes, when interviewed, had seen only one of the Kendall team's unpublished studies. Based on the methods, Dr. Hayes said he was not surprised they had not replicated his results. He said that the researchers had raised the frogs under unhealthy conditions and that they did not properly control levels of atrazine in the frogs' water.

"Even if their animals were healthy, you can't compare them to our study," he said. But Dr. Jim Carr, comparative endocrinologist at Texas Tech and a member of Dr. Kendall's team, said that in another study team members had mimicked Dr. Hayes's experimental conditions more closely but still did not produce his results. Dr. Carr and colleagues have also criticized Dr. Hayes's omission of certain experiments considered standard. "There are not a lot of details published in the Hayes work," said Dr. Carr. "So it's hard to compare."

Yoon, Carol Kaesuk. "Studies Conflict on Common Herbicide's Effects on Frogs." *New York Times*. 19 Nov 2002. 29 Feb 2008.
<<http://query.nytimes.com/gst/fullpage.html?res=940DE5D91130F93AA25752C1A9649C8B63>>

“Scientific Integrity” Union of Concerned Scientists

Document Excerpt #4

Reports and Research: Chemical Industry Pressures EPA to Protect Herbicide, not Wildlife

Despite compiling hundreds of pages of evidence documenting the harmful effects of atrazine, a commonly used weed killer, the Environmental Protection Agency (EPA) refused to regulate the herbicide. Atrazine has been found to cause severe hormonal damage to wildlife, including amphibians, reptiles and fish. The European Union banned the herbicide because of safety concerns in October 2003, but at almost the same time, the EPA decided to re-approve atrazine for continued use in the United States.

The Washington Post reported that a petition filed with the EPA by Washington lobbyist Jim J. Tozzi provided the main rationale for the “reregistration” of atrazine with no new restrictions.¹ Tozzi, working closely with atrazine’s primary manufacturer, Syngenta Crop Protection, developed a two-pronged attack on the science that questioned atrazine’s safety. First, the petition argued that hormone disruption, even when clearly proven in scientific studies, cannot be used as a reason to restrict a chemical’s use, because the government has not yet settled on an officially sanctioned test for measuring such disruption. The EPA adopted this reasoning in their decision, stating: “The Agency’s ecological risk assessment does not suggest that endocrine disruption, or potential effects on endocrine-mediated pathways, be regarded as a regulatory endpoint at this time.”

Secondly, the petition sought to cast doubt on independent scientific studies linking atrazine to endocrine disruption, citing a little known piece of legislation called the Data Quality Act.³ The Data Quality Act, which allows stakeholders to challenge the accuracy of information used in regulatory decision-making, was actually drafted by Tozzi and slipped into a 2000 omnibus spending bill without debate or comment. The Post reported that the Act has been primarily used by industry to challenge the basis for regulations.

The ecological impact of atrazine has been widely studied. According to the Center for Biological Diversity, the herbicide has been linked to declines in sea turtles, sturgeons, mussels and various amphibians. Most notably, atrazine has been found to produce hormonally confused frogs, turning them “into bizarre creatures bearing both male and female sex organs.”

Dr. Tyrone B. Hayes of the University of California at Berkeley, originally hired by the chemical company Syngenta to review studies to help certify the herbicide for re-registration with the EPA, was at first surprised when he found that African clawed frog tadpoles were “chemically castrated” when exposed to even trace amounts of atrazine – levels one-thirtieth the amount currently permitted in US drinking water. Hayes’ findings were published in both *Nature* and the *Proceedings of the National Academy of Sciences*.

Hayes, who eventually resigned from the Syngenta review panel out of concern that his worrisome lab results were being buried, later charged that industry-supported scientists produced “a number of studies that were purposely flawed and misleading, and that changed the weight of the evidence.” The two remaining members of Syngenta’s atrazine review panel claimed that they had each tried but failed to replicate Hayes’ data. In the scientific world such a claim is an insult or worse, implying that the original experiment may have been dishonest or flawed. In this case, the two scientists had both experienced difficulties raising the frogs—many of which died before metamorphosis because of being overcrowded and underfed. One scientist reported that he had contaminated the water with too much atrazine.

In other words, the new studies did nothing to disprove Hayes' results, which have been "echoed by at least four other independent research teams in three countries." When Hayes offered to help the Syngenta panel members and the EPA repeat his experiments to see for themselves whether atrazine posed a danger, the EPA declined. Nonetheless, the failed studies served to bolster the argument that the science linking atrazine to hormone disruption was uncertain.

The EPA, however, did not only deem the atrazine data inconclusive; the agency allowed the chemical industry to effectively set the course of future action. As the Post reported, "in closed meetings—details of which the EPA has declined to release—company representatives and EPA officials worked out a plan to avoid tighter restrictions." Independent scientists and environmental groups were excluded from these negotiations. The Center for Biological Diversity reports that in the final deal, continued oversight of atrazine will be provided by atrazine manufacturers, who will be responsible for monitoring three percent of "at risk" watersheds.

The Natural Resources Defense Council sued the EPA over its approval of atrazine, saying that with the decision to re-register the herbicide, the EPA effectively bought into the chemical industry's effort to obscure perfectly clear science. Jennifer Sass, a scientist with the Natural Resources Defense Council, charges that the negotiated settlement went forward without any "scientific rationale." By accepting suspect industry science, minimizing well regarded and peer-reviewed scientific studies, and putting the chemical industry in charge of future data collection, the Bush administration showed its disregard for independent science.

"Scientific Integrity." Union of Concerned Scientists. 12 Dec 2006. 29 Feb 2008.
<http://www.ucsusa.org/scientific_integrity/interference/atrazine-and-health.html>