

The waters of death: pesticides in the Willamette River

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The Willamette River is polluted with many different substances, fecal material from inadequately-treated sewage, mercury from abandoned mines, toxic waste from underwater dump sites, and trash from people using the area for recreation. Some sources of pollution, such as the extremely high levels of nitrates, phosphates, and potassium from cow manure, are naturally occurring and hard to control¹. Others are entirely the product of human use, and can be controlled through human behavior. One of these is pesticide.

Presently there are a number of scientific studies available that list the types and amounts of different pesticides detected in areas of the Willamette River. One study reported by the Northwest Coalition for Alternatives to Pesticides (NCAP) describes the results of a United States Geological Survey (USGS)². At forty different sites along the river, ninety-four water samples were collected and tested (see Fig. 1). At each site the investigators found a median number of eight contaminants. Several of these pesticides have already been linked to breast cancer and male fertility problems, and many more may be once they've been studied².

The most common pesticides were atrazine, metolachlor, simazine, and diuron. Atrazine has been shown to cause breast cancer in rats, and is nearly as harmful as DDT in that respect. It has also been associated with interference in testosterone metabolism

and binding. Metolachlor has not been shown to have harmful reproductive effects, but it can cause serious intoxication in humans if inhaled³. Symptoms include abdominal cramps, anemia, shortness of breath, dark urine, convulsions, diarrhea, jaundice, weakness, nausea, sweating, and dizziness³.

Figure 1. Chemicals detected in the Willamette River and associated human health problems.

Chemical tested	Percent of Samples containing chemical	Linked to breast cancer?	Linked to male fertility problems?
Atrazine	90	YES	YES
Simazine	82	YES	YES
Metolachlor	81	no	no
Desethylatrazine	61	no studies yet	no studies yet
Diuron	54	no	no
Hexazinone	48	no studies yet	no studies yet
Diazinon	47	no studies yet	YES
Cycloate	43	no studies yet	no studies yet
Desisopropylatrazine	40	no studies yet	no studies yet
Terbacil	37	no studies yet	no studies yet
DCPA (Dacthal)	35	no studies yet	no studies yet
EPTC	32	no studies yet	no studies yet
Napropamide	29	no studies yet	no studies yet
Prometon	29	YES	no studies yet
Chlorpyrifos	26	no studies yet	YES
Ethoprop	26	no studies yet	no studies yet
Fonofos	26	no studies yet	no studies yet
Carbaryl	23	no studies yet	YES
Carbofuran	23	no studies yet	YES
Tebuthiuron	23	no	no
Metribuzin	21	no studies yet	no studies yet
Pronamide	20	no	YES
Trifluralin	17	no studies yet	no
Trichlopyr	13	no studies yet	no studies yet
2,4-D	12	no studies yet	YES

Adapted from "Altering," p. 5².

Metolachlor is moderately toxic to trout and carp³. Simazine was demonstrated to cause breast cancer in rats and atrophied testes in sheep². An Environmental Protection Agency (EPA) study showed that animals exposed to amounts of simazine above Maximum Contaminant Levels for even short periods of time developed changes in blood and weight loss⁴. Diuron, although not shown to cause cancer, is moderately toxic to fish and highly toxic to aquatic invertebrates⁵.

Similar results were shown in a USGS study in 1997. Samples of water from sixteen different sites were collected and tested for various pesticides and suspended sediment⁶. The most commonly found pesticides were atrazine, desethylatrazine, simazine, metolachlor, and diuron, out of a list of eighty-six pesticides⁶. Desethylatrazine is a compound derived from chemical action from atrazine, and may be more toxic than atrazine². Fortunately, most of these chemicals have harmful effects on humans only through consumption and not dermal contact. The standard used by the EPA in assessing the risks of pesticides is that there must be a “reasonable certainty of no harm” if traces of the pesticide contaminate food⁷.

The water from the Willamette River is used for many purposes. The safest contact people have with the water is through swimming and other recreational uses and irrigation of crops⁸. The most potentially dangerous to people’s health is through consumption of fish from the river and drinking the river water. Most people consume one or less fish meal per month, which is below the maximum contaminant levels, but subsistence anglers consume nineteen or more meals of fish per month⁹. Compounding this health hazard are the factors that subsistence anglers have fewer alternatives to Willamette River fish (hence the term subsistence) and they are also less likely than most

anglers to be informed about the health risks of consuming the fish. In other words, those who are most at risk are the least protected.

Some pesticides detected in fish in a study by the Oregon Department of Environmental Quality are aldrin, dieldrin, and DDE⁹. Aldrin and dieldrin are acutely toxic chemicals^{10, 11}. These insecticides break down very slowly and are stored in the soil, in plants, and in animal organisms¹¹. According to the Agency for Toxic Substances and Disease Registry, “people who intentionally or accidentally ingested large amounts of aldrin or dieldrin suffered convulsions and some died”¹¹. Even people who consume smaller amounts of the chemicals over longer periods of time (such as subsistence anglers) suffer negative health effects¹¹. DDE (dichlorodiphenyldichloroethylene) is a byproduct of DDT (dichlorodiphenyltrichloroethane) and is associated with a multitude of health problems, including problems with fertility, lactation, the nervous system, and the liver¹².

There is no longer any doubt about the presence of pesticides in the Willamette River. Now the question is only which ones, and how much of each.

The history of pesticide pollution and how it gets to the river

The first pesticides used were naturally occurring, highly toxic substances such as arsenic and hydrogen cyanide¹³. These were eventually abandoned in favor of more specialized, synthetic chemicals such as DDT. Since DDT was cheap, not water soluble, and seemed to harm only insects, it was hailed as a miracle pesticide¹³. From the mid-1940s until the 1960s DDT and other synthetic chemicals were used widely in the U.S. without much concern about long-term effects on humans and the environment. But

starting with the environmental movement people became much more aware of the negative side effects of these chemicals, including effects on nontarget species, the chemicals' persistence in the environment, and indirect toxicity (for example, birds died from eating contaminated worms and insects)¹³. The further up the food chain, the more chemicals were detected—"DDE is the most widespread contaminant in human milk around the world"¹³. But the ban on DDT came too late, considering its long half-life. Recovery of wildlife is slow, and harmful levels of DDT and its byproducts, DDD and DDE, are still found today in animals, plants, soil and water¹³.

Pesticides seem like an unexpected type of river pollution for the layperson, since the chemicals are sprayed on land and not dumped directly into the water. Unfortunately, pesticides' roundabout way of polluting the river also makes them harder to control. In a USGS study, researchers traced the local stream content of certain chemicals back to the Oregon Department of Transportation's application of those herbicides to control weeds along the shoulders of roads¹⁴. Through excessive application and rainfall soon afterwards, most of the chemicals were washed into nearby streams and carried to the larger river. The same has been demonstrated in crop use of pesticides, as well as in road construction, residential and commercial landscaping, and homeowner use⁶.

Farmers and landscapers aren't wasting pesticides on purpose; rather, they lose much of the chemicals through misapplication and ignorance. Pesticides are expensive and dangerous to work with, and if the users were better educated about pesticide runoff they would no doubt be more careful. By following the instructions exactly, checking weather forecasts to apply the chemicals during dry periods, and not repeating the application, pesticide users could reduce their runoff pollution and save money as well.

Regulations on pesticide use

The existing pesticide law, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires all pesticides to be registered². However, the sheer volume of products coupled with inadequate funding and resources makes that an impossible task. In effect, there is no regulation of pesticide use. Until recently the registration of pesticide information has been voluntary and incomplete. The last comprehensive survey of annual pesticide use in the Willamette Valley was in 1987, and those data are largely useless by now². Legislators are starting to recognize the need for a systematic registration of the type and amount of pesticides used. Over the last few years, the EPA has been reviewing pesticides registered prior to 1984 to make sure they meet the conditions of the Food Quality Protection Act of 1996¹⁵. The first group of pesticides to be reviewed are the organophosphates, which have been demonstrated to affect the nervous system¹⁵.

The Oregon Legislature in 1999 made a half-hearted attempt to regulate the use of pesticide with its “Pesticide Right to Know Law.” House Bill 3602 established the Pesticide Use Reporting System (PURS), which requires pesticides to be registered and fees to be paid for pesticide use¹⁶. The authors of the bill claim its purpose is “protecting public health, water quality and fish and wildlife” (section 7). However, the bill does not include stringent requirements, and it does include many clauses that defeat its intended purpose. One of these is that the information collected by PURS will not be available to the public (ironically, the Pesticide Right to Know Law doesn’t actually provide the right to know), and another is the prohibition of lawsuits against pesticide users¹⁶. However, the bill may have some good effects in the end. The Department of Agriculture is

required to compose a pesticide use manual and to release an annual report on pesticide use in the Willamette watershed¹⁶. The legislature cannot act freely to protect water quality because many of Oregon's voters are farmers who rely on the pesticides, and many politicians in Salem are trying to attract developers to the state by not imposing strict regulations on construction measures.

The best measure extant for controlling the levels of pesticides used is the Total Maximum Daily Load (TMDL) process. The TMDL process calculates the maximum amount of a contaminant that a body of water can sustain and still not be a threat to human or ecological health, and divides that amount between the pollutant's various sources¹⁷. In this way, each source (e.g., a city, farm, construction site) has a specific number indicating the amount of a given chemical they can use. This is a good measure because it focuses on the end product of pesticide use (water pollution) and not on the initial demand for its use at the retailer, as the Pesticide Right to Know Law does. The TMDL process uses specific amounts of specific chemicals, so there's no room for misunderstanding or speculation.

On the other hand, the TMDL process is really a monitoring system of the EPA, and doesn't have the legislation to require adherence to its policies. It's a good system, but only a suggested one. At least the Pesticide Right to Know Law has the power of the government behind it.

Remediation

So where does this leave us? The Willamette River is replete with toxins, pesticides are unstudied and used carelessly, and the legislation to regulate their use is

ineffectual. Removing pesticides from the waters is going to be an uphill task, perhaps Sisyphean. After all, the Willamette was restored to health and cleanliness in the 1960s and 1970s, only to deteriorate a second time.

Nevertheless, there is hope. Many different groups are working to establish recommendations for future action. One of these is the Willamette Restoration Initiative (WRI), created by Governor Kitzhaber in 1998¹⁷. The WRI reviewed numerous studies of the Willamette River and its health problems and composed a report with a list of twenty-seven critical actions for restoring the river. These actions are separated into categories by clean water, water quantity, habitat and hydrology, and institutions and policies¹⁷. The actions are a balance between legislation supporting current environmental measures and creating financial and educational incentives for developers and city planners to use these measures. These recommendations are useful because they are highly practical, and they address the issues from a developer's viewpoint as well as an environmentalist's.

The Northwest Coalition for Alternatives to Pesticides also provides a list of recommendations. First and foremost is to improve public information and education about river health². Second, rather than limiting or measuring the amount of pesticides used on farms and construction sites, NCAP encourages the use of alternative measures to rid the area of pests, and abandoning use of pesticides altogether². This recommendation would likely encounter great resistance from farmers, developers, and legislators, although it is the most environmentally sound of all the recommendations I've read. Their last recommendation is to support farmers and other "pest managers" who use alternatives to pesticides². This is an important step towards total elimination of

pesticide use. If the government would provide more incentives and rewards for organic farmers and developers, others might adapt their behavior. They would almost certainly do so more willingly in hopes of a reward rather than in fear of punishment.

Basically, my own recommendation incorporates the others. First, the public (not only pesticide users) needs to be informed about the environmental and human health effects of pesticides. Those who use pesticides must understand what the chemicals are, what they do, and the safest and most efficient methods of use. Those who do not use pesticides should be informed so they can decide which farmers and industries to support. The problem with ignorance and indifference is that people believe they are making no choice and remaining neutral when really, without awareness of it, their actions and purchases support one side or the other of the pesticide debate. These people need to be informed so they can understand the impact they already have.

Second, the government must establish some legislation to control the purchase and application of pesticides (that is to say, legislation with actual regulatory power). This agency, whether part of the EPA, DEQ, or a new body altogether, must have the power to fine and sue pesticide users for violation of the regulations. They need specific regulations with specific requirements for chemical type, amount, and use, or the whole venture will be brushed aside.

Last, the government needs to provide incentives for those farmers and developers who already incorporate environmentally sound measures in their use of pesticides. These incentives could be in the form of financial rewards, tax breaks, or simply preference when the government is shopping for a provider of some service. The public must also mirror these incentives by buying selectively to support alternatives to

pesticides. This will not only allow those businesses to succeed but it will demonstrate to other businesses that it is commercially viable to adopt environmental measures.

If all three of these recommendation were followed, the ultimate goal of zero pesticide use might be realized. It is also important to remember that the U.S. does not exist in a vacuum, and the actions we take now and their future consequences will be seen and judged around the world. If we succeed in implementing environmental measures and cleaning up the Willamette River once more (and for good), we will be held up as an example to the rest of the world, and those same measures will be emulated and adopted, to the benefit of humans and ecosystems everywhere. If we present a weak and unorganized attempt to restore the Willamette to health, the situation will only get worse. Oregon will lose a large part of its natural beauty and biodiversity, and the river will truly become the waters of death.

Bibliography

- 1 Lecture by Paul Engelking on chemical contaminants of the Willamette River on 4/13/2004.
- 2 “Altering Oregon’s Destiny: Hormone-Disrupting Pesticides in the Willamette River.” Northwest Coalition for Alternatives to Pesticides, 1997. Available online at <http://www.pesticide.org/willreport.pdf>. Accessed on 4/30/2004.
- 3 EXTOWNET. “Pesticide Information Profiles: Metolachlor.” Pesticide Management Education Program; A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis, 1993. Available online at <http://pmep.cce.cornell.edu/profiles/extownet/metiram-propoxur/metolachlor-ext.html>. Accessed on 5/25/2004.
- 4 “Consumer Factsheet on: Simazine.” Environmental Protection Agency, 2004. Available online at http://www.epa.gov/safewater/contaminants/dw_contamfs/simazine.html. Accessed on 5/25/2004.

- 5 EXTOXNET. "Pesticide Information Profiles: Diuron." Pesticide Management Education Program; A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis, 1996. Available online at <http://extoxnet.orst.edu/pips/diuron.htm>. Accessed on 5/19/2004.
- 6 Anderson, Chauncy, Tamara Wood, & Jennifer Morace. "Distribution of Dissolved Pesticides and Other Water Quality Constituents in Small streams, and Their Relation to Land Use, in the Willamette River Basin, Oregon 1996." USGS Water-Resources Investigations Report 97-4268, 1997.
- 7 "Human Health Issues." The Environmental Protection Agency, 2004. Available online at <http://www.epa.gov/pesticides/health/human.htm>. Accessed on 5/29/2004.
- 8 Boudin, J. "Protecting and Restoring the Willamette River." Oregon Department of Environmental Quality, 2003. Available online via link at <http://www.deq.state.or.us/wq/willamette/WRBFactSheets.htm>. Accessed on 4/1/2004.
- 9 White, Brian. "Middle Willamette River Fish Consumption Study." Oregon Department of Environmental Quality, 2000. Available online via link at <http://www.deq.state.or.us/wq/willamette/WRBFactSheets.htm>. Accessed on 4/2/2004.
- 10 Orme, S., & S. Kegley. "Aldrin—Pesticide Use Statistics for 2002." PAN Pesticides Database, 2004. Available online at http://www.pesticideinfo.org/Detail_ChemUse.jsp?Rec_Id=PC35039. Accessed on 5/19/2004.
- 11 "ToxFAQs for Aldrin/Dieldrin." The Agency for Toxic Substances and Disease Registry, 2002. Available online at <http://www.atsdr.cdc.gov/tfacts1.html>. Accessed on 5/22/2004.
- 12 "ToxFAQs for DDT, DDE, and DDD." The Agency for Toxic Substances and Disease Registry, 2002. Available online at <http://www.atsdr.cdc.gov/tfacts35.html>. Accessed on 5/22/2004.
- 13 Muir, Patricia. "History of Pesticide Use." Oregon State University, 2002. Available online at <http://oregonstate.edu/instruction/bi301/pesthist.htm>. Accessed on 5/24/2004.
- 14 Wood, Tamara M. "Herbicide Use in the Management of Roadside Vegetation, Western Oregon, 1999-2000: Effects on Water Quality of Nearby Streams." USGS Water-Resources Investigations Report 01-4065, 2001.

- 15 “Pesticide Tolerance Reassessment and Reregistration.” The Environmental Protection Agency, 2004. Available online at <http://www.epa.gov/pesticides/reregistration/index.htm>. Accessed on 5/30/2004.
- 16 Avery, Whitney. “State of Oregon, 70th Legislative Assembly- Regular Session 2003. House Bill 3602.” Salem: Oregon State Printing Office, 1999. Review of bill available online at <http://darkwing.uoregon.edu/~dtodd/WilRiver/Avery3.htm>. Accessed on 5/29/2004.
- 17 Jerrick, Nancy. “Restoring a River of Life: The Willamette Restoration Strategy Overview.” Willamette Restoration Initiative, 2001.