Pesticides in Oregon Surface Water
1969-2004

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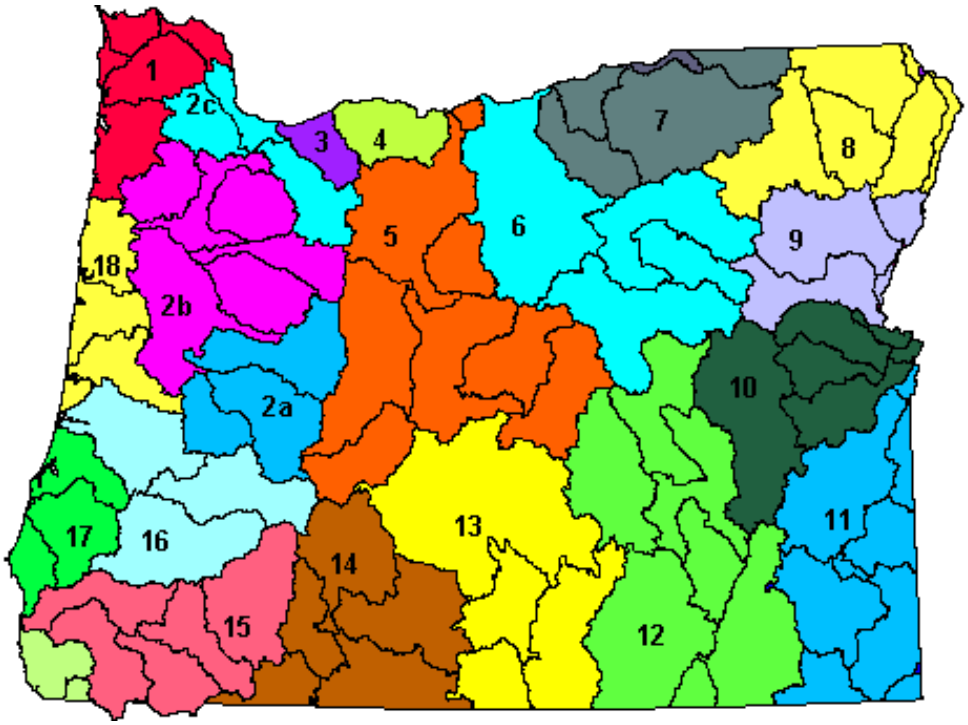
Introduction

As part of the Oregon Department of Agriculture's (ODA) participation in the U. S. Environmental Protection Agency's (EPA) Pesticides and Groundwater Strategy, a cooperative agreement between ODA and the Agricultural Chemistry Research and Extension program, Department of Environmental and Molecular Toxicology, Oregon State University (OSU) was established in FY96 and continued through FY2004. The aim, in part, was to develop a pesticides and groundwater database as a part of Oregon's Generic State Pesticide Management Plan (PMP). The data reported here supplement that previously provided in the reports "Pesticides and Groundwater Quality in Oregon, 1984-1996" and "Pesticides and Groundwater Quality in Oregon, 1997-2003." Surface water monitoring data was obtained from the following sources: the U.S. Geological Survey (USGS), and Oregon Department of Human Services (DHS) Drinking Water Program, Oregon Department of Environmental Quality (DEQ), Oregon Department of Agriculture, and Oregon State University (OSU). The surface water database, when combined with the groundwater database, will result the "Database of Pesticides Found in Oregon Waters."

In developing the Pesticides in Oregon Surface Water database, the U. S. Environmental Protection Agency (EPA) STORET database was queried for pesticides sampled in Oregon surface water. The STORET system has undergone significant updating in structure and access and is now available via the internet [http://www.epa.gov/storet/]. Data retrieval is less arduous; however, the data still require significant formatting to make them applicable to current scientific and regulatory efforts related to watershed and drainage basin organization and to keep them compatible with the existing Oregon database. Data uploaded to STORET include groundwater (wells, aquifers) and surface water (lakes, streams, runoff, reservoirs) pesticide detections, plus a large amount of data on a variety of water quality parameters such as pH, dissolved oxygen, temperature, conductivity, and non-pesticide chemical detections.

Data in STORET are generated for a variety of reasons. Virtually any agency or group collecting data can upload its data to STORET. Therefore, the Clean Water Act (CWA), Safe Drinking Water Act (SDWA), and other programs are likely catalysts for conducting monitoring and sampling, but such data are not required to be uploaded to STORET. The following entities are identified by STORET as contributing some type of environmental sampling data: Oregon Department of Environmental Quality, U.S. Environmental Protection Agency, U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Forest Service, National Marine Fisheries Service, U.S. Fish & Wildlife Service, U.S. Army Corp. of Engineers, National Oceanic and Atmospheric Administration.

Figure 1. Major Drainage Basins in Oregon.



1	North Coast
2a	Upper Willamette
2b	Middle Willamette
2c	Lower Willamette
3	Sandy
4	Hood
5	Deschutes
6	John Day
7	Umatilla
8	Grande Ronde
9	Powder
10	Malheur
11	Owyhee
12	Malheur Lake
13	Goose and Summer Lakes
14	Klamath
15	Rogue
16	Umpqua
17	South Coast
18	Mid Coast

For the purposes of updating the Pesticides in Oregon Groundwater database, STORET was queried for pesticide surface water monitoring data. We found that no Oregon surface water monitoring data was submitted to STORET by any state or federal agency during that period. However, pesticide monitoring data not submitted to STORET was obtained from DEQ, ODA, DHS, USGS, and OSU directly. Some surface water samples collected by DEQ were analyzed by the Oregon Department of Agriculture (ODA) Laboratory Services.

In accordance with amendments to the Safe Drinking Water Act (SDWA), DHS has expanded requirements for sampling and analysis of community drinking water systems for organic chemicals, including pesticides. Currently, there are approximately 1,200 systems in the DHS database. The DHS drinking water monitoring program is conducted under requirements of the SDWA and includes 86 contaminants, approximately 25 of which are pesticides. Water systems serving >3,300 population require two consecutive quarterly samples during one year of the compliance period (the current 3-yr period runs Jan. 2002 to Dec. 2004). Sampling may be less frequent if the system has a Drinking Water Protection program in place. Data are obtained directly from DHS and provided in database format.

Surface water monitoring data was also obtained from USGS. USGS has conducted the majority of the monitoring for pesticides in Oregon surface water. In recent years monitoring for pesticides in surface groundwater has been a part of the USGS National Water Quality Assessment (NAWQA) Program.

Consistent with the report on pesticides in Oregon groundwater, data have been segregated into 18 drainage basins, as defined by Oregon Department of Water Resources. The Willamette Basin is further subdivided into three sub-basins, to give a total of 20 geographic areas (See Figure 1.)

Data is further subdivided by agency to address differences in sampling and analytical capabilities. The most notable difference between agencies is the limit of detection of the analytical methods used. USGS and ODA detection limits are often orders of magnitude lower than those employed by DHS. This difference reflects monitoring strategies of the agencies, as the cost of analysis at lower levels is significant. The cost of further decreasing detection limits orders of magnitude below health based standards or guidelines may not be warranted if the goal is to assure all Oregonians safe drinking water. However, the cost may be warranted if the goal is to better understand the relationship between pesticide use practices and groundwater quality, or to establish trends that allow researchers to predict future impacts. In addition, in the 25 years since the first surface monitoring data was reported improved analytical methods and instrumentation have resulted in increasingly lower detection limits. Consequently, older monitoring data for which no pesticides were detected was most likely based on higher limits of detection.

The EPA Office of Water has established Health Advisories (HAs), which are non-enforceable guidelines for chemical residues in drinking water, for approximately 200 chemicals, including about 50 pesticides. These include 1-day and 10-day HAs for children and adults and lifetime HAs for adults. The HA is the concentration of a chemical in drinking water that is not expected to cause adverse non-carcinogenic effects over the period of exposure. EPA has also established HAs for some pesticides classified as carcinogens. In addition, as a part of rulemaking under the

Safe Drinking Water Act, the agency has established the Maximum Contaminant Level (MCL) and Maximum Contaminant Level Goal (MCLG) for about 25 pesticides in drinking water. The MCL, an enforceable standard, is the maximum allowable level of a contaminant in water delivered by a public water system. The MCLG is the concentration of a drinking water contaminant that is thought to be protective of adverse human health effects. In almost all cases, the MCL and MCLG are the same. In a few instances, the MCLG has been set at zero. Pesticides looked for in Oregon groundwater with zero MCLGs are these: acifluorfen, alachlor, chlordane, HCB, heptachlor, heptachlor epoxide, and pentachlorophenol (PCP). In determining the lifetime HAs and MCLGs, the estimated dose is based on a 70 Kg person consuming 2 liters per day. For non-carcinogens, lifetime HAs and MCLs are derived from the drinking water equivalent to the Reference Dose (RfD). The RfD is an estimate of total human daily exposure to contaminants that is unlikely to result in adverse health effects over a lifetime. For carcinogens, the excess cancer risk associated with lifetime ingestion of drinking water is estimated. The target for the lifetime HA or MCLG is a concentration in drinking water that results in less than 1 in 10,000 (1×10^{-4}) excess lifetime cancer risk. In determining the risk of consuming contaminated drinking water, other routes of exposure, such as diet, are considered so that the risk associated with the total daily exposure from all sources does not exceed the drinking water equivalent to the RFD for non-carcinogens or the 1 in 1,000,000 (1×10^{-6}) excess lifetime cancer risk for carcinogens. In the absence of actual data, it is generally assumed that drinking water comprises 20% of all routes of exposure.

The World Health Organization (WHO) also publishes drinking water quality guidelines that are intended to be used as a basis for the development of national standards. See WHO Guidelines for Drinking Water Quality, Volume 2 (1996).

Listed in Appendix A in order of preference are the MCLs, followed by HAs. If these values are not available, the WHO drinking water guideline is given. If MCL, HA, or WHO data are not available, then a HA was calculated from the DWEL (Drinking Water Equivalence Level, EPA, 1989). The DWEL is determined from the RfD assuming a 70 Kg person consumes 2 liters per day for a lifetime. To determine the HA, the DWEL is adjusted assuming that drinking water comprises 20% of the allowable daily intake of a given chemical. Use a HA determined from the DWEL assumes that there is no non-threshold lifetime cancer risk, or the HA calculated for cancer risk would be greater than that calculated using the DWEL. Also see Appendix A.

Raw data was obtained from the Oregon Department of Human Services, Drinking Water Program as a Microsoft Access database; Oregon Department of Environmental Quality as a Microsoft Excel spreadsheet; and the U.S. Geological Survey as a text delimited file downloaded from their web site. All data was converted into Access and combined into a 'normalized' set of data fields. These data fields are agency, drainage basin, site number, sample date, parameter name, result, units, and detection limit. The normalized database also includes unit conversion to standardize concentration as micrograms per liter (ug/l.) Using Access SQL functions, the ‘normalized’ data was sorted into basins and separated by detections and non-detections. Simple statistics (high, low, mean, median, standard deviation) were performed in Excel. Raw data and the normalized Access database are contained on a separate CD. The normalized database is presented in basin format in Appendix B.

Pesticides detected in Oregon surface water from 1968 to 2004 are given in Appendix B. Results are reported by basin or sub-basin. Data presented include organization that conducted the monitoring and analysis, a station identifier, a location descriptor, the sampling date, the parameter (pesticide or semi-volatile organic), the concentration in micrograms per liter (ug/l), and the detection limit when reported. Due to the large number of records, for the Lower and Middle Willamette sub-basins and the North Coast Basin only records for which there was a detection are reported. The entire database is also available as an Access database on CD.

Results

The results of our inquiry regarding pesticides monitored in Oregon surface water found that between 1968 and 2004 over 84,000 analyses were performed on approximately 200 pesticides. No monitoring data was found for five basins: Deschutes, Goose and Summer Lakes, Klamath, Powder, and Umatilla. For the 15 basins and sub-basins with monitoring data, pesticides were detected in surface water all basins except Grande Ronde, and South Coast basins. In the John Day, Malheur Lake and Rogue basins only 1 pesticide was detected. There were roughly 4000 detections for all basins or about 5% of the samples analyzed. The span in years that pesticides were monitored, number of pesticides detected, and number of detections in each of the basins are as follows. Grande Ronde- 45 pesticides and metabolites monitored from 1970 to 2003 resulting in 259 analyses and no pesticides detected; John Day- 27 pesticides and metabolites monitored from 1974 to 1982 resulting in 575 analyses and 1 pesticide detected with a total of 2 detections; Lower Willamette- 120 pesticides and metabolites monitored from 1977 to 2003 resulting in 24,873 analyses and 56 pesticides detected with a total of 1175 detections; Malheur- 49 pesticides and metabolites monitored from 1990 to 2003 resulting in 254 analyses and 10 pesticides detected with a total of 34 detections; Malheur Lake- 18 pesticides monitored in 1988 resulting in 36 analyses and 1 pesticide detected with a total of 1 detection; Mid Coast- 50 pesticides and metabolites monitored from 1980 to 2003 resulting in 498 analyses and 1 pesticide detected with a total of 1 detection; Mid Willamette- 120 pesticides and metabolites monitored from 1972 to 2004 resulting in 35,578 analyses and 84 pesticides detected with a total of 2500 detections; North Coast- 131 pesticides and metabolites monitored from 1975 to 2003 resulting in 791 analyses and 17 pesticides detected with a total of 191 detections; Owyhee- 34 pesticides and metabolites monitored from 1990 to 2002 resulting in 161 analyses and 9 pesticides detected with a total of 30 detections; Rogue- 45 pesticides and metabolites monitored from 1975 to 2003 resulting in 791analyses and1 pesticide detected with a total of 1 detection; Sandy- 115 pesticides and metabolites monitored from 1980 to 2003 resulting in 3120 analyses and 18 pesticides detected with a total of 59 detections; South Coast- 45 pesticides and metabolites monitored from 1980 to 2003 resulting in 398 analyses and no pesticides detected; Umpqua- 120 pesticides and metabolites monitored from 1969 to 2004 resulting in 2635 analyses and 8 pesticides detected with a total of 44 detections; Upper Willamette- 179 pesticides and metabolites monitored from 1991 to 2004 resulting in 1091 analyses and 7 pesticides detected with a total of 8 detections.

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and the detection limit when reported. Due to the large number of records, for the Lower and Middle Willamette sub-basins and the North Coast Basin only records for which there was a detection are reported. The entire database is also available as an Access database on CD.

Also, not reported here are monitoring data for the Hood River Basin. As a result of quality assurance procedures discrepancies were detected in which we are currently attempting to resolve.