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Wyoming Department of Agriculture

Prepared in cooperation with Wyoming Department of Agriculture

Pesticides in Wyoming's Rivers, 2006–10

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Introduction

In 2006, the U.S. Geological Survey (USGS) completed a study in cooperation with the Wyoming Department of Agriculture (WDA) to determine the occurrence of pesticides in four major rivers within the Bighorn and North Platte River Basins in Wyoming (Eddy-Miller and others, 2007). Surface-water samples were collected at five sites (fig. 1) during three different times of the year and detectable concentrations of pesticides were measured in samples collected during all three sampling events (table 1). In 2009–10, the USGS, in cooperation with the WDA, resampled three of the sites from the 2006 study and three additional sites (fig. 1) located in areas of interest to the State of Wyoming to further describe the occurrence of pesticides in Wyoming's rivers. The change was made in order to include sites located near cities and towns. Results from the 2009–10 sampling along with comparisons to data collected in 2006 are presented in this fact sheet.

Sample Collection and Analyses

For the 2009–10 sampling, two samples were collected from each of the six sites, one in late summer (August or September) 2009 and one in mid-spring (April or May) 2010. The late summer sampling corresponded with the late growing season and the mid-spring sampling corresponded with post-application of pesticides. The samples were collected using standard methods described in the National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated) and sent to the

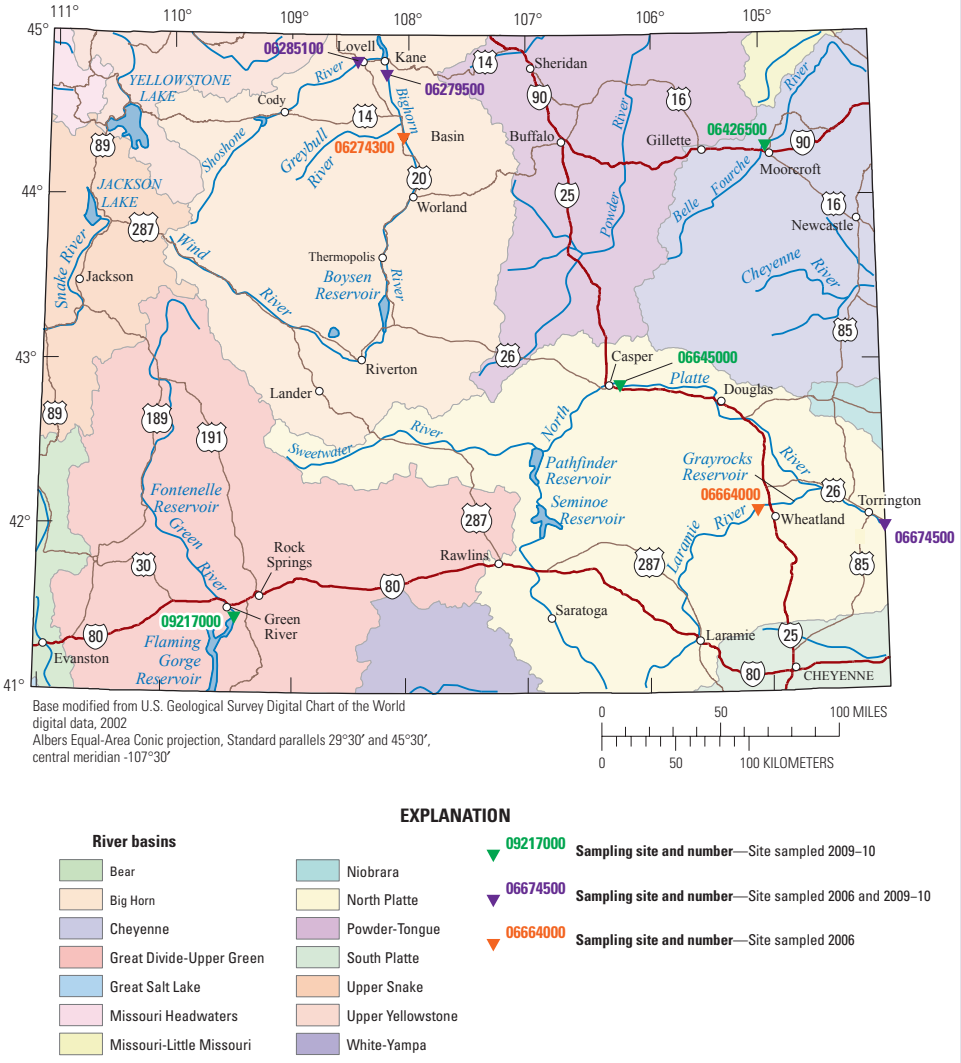

Figure 1. Sites sampled in 2009–10 were located in the Bighorn, North Platte, Green, and Belle Fourche River Basins.

North Platte River below Casper, Wyoming sampling site.

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Table 1. Pesticides and degradates analyzed in 2006 (Eddy-Miller and others, 2007) and 2009–10 sampling.

[Pesticide trade names[1] and degradate names in parentheses if different from pesticide name (Meister, 2002); pesticide abbreviations are given in braces; pesticides in color were detected in the corresponding year(s): yellow, 2006; pink, 2006 and 2009–10; purple, 2009–10]

Pesticide name	Pesticide name	Pesticide name	Pesticide name
Acetochlor (Guardian, Harness, Relay)	2,4-D (Dacamine, Weed-B-Gon)	Fipronil sulfone (fipronil degradate)	Oxamyl (Vydate)
Acifluorfen (Blazer, Tackle 2S, Astic)	2,4-D methyl ester	Flumetsulam (Broadstrike)	Oxyfluorfen (Offside, Goal)
Alachlor (Alanex, Lasso, Shroud)	2,4-DB (Butoxone, Butyrac)	Fluometuron (Cotoran)	Paraoxon-methyl (parathion-methyl degradate)
Aldicarb (Temik)	Dacthal	Fonofos (Dyfonate)	Parathion-methyl (Alkron, Bladan, Fighter)
Aldicarb sulfone (Standak, aldicarb degradate)	Dacthal monoacid (Dacthal degradate)	Glufosinate[2]	Pendimethalin (Prowl, Stomp)
Aldicarb sulfoxide (aldicarb degradate)	Desulfinylfipronil (Fipronil degradate)	Glyphosate[2]	cis-Permethrin (Ambush, Pounce)
Aminomethylphosphonic acid (glyphosate degradate)[2]	Desulfinylfipronil amide (Fipronil degradate)	Hexazinone (Velpar)	Phorate (Thimet, Rampart)
Atrazine (Aatrex, Atranex)	Diazinon (Basudin, Spectracide, Knoxout)	3-Hydroxycarbofuran (carbofuran degradate)	Phosmet (Imidan)
Azinphos-methyl (Guthion, Crysthyon)	Dicamba (Banvel, Banex)	2-Hydroxy-4-isopropylamino-6-ethyl-amino-s-triazine {OIET} (atrazine degradate)	Picloram (Tordon)
Azinphos-methyl-oxon (azinphos-methyl degradate)	3,4-Dichloroaniline (Chloramben degradate)	Imazaquin (Scepter)	Prometon (Pramitol, Gesafram)
Barban	3,5-Dichloroaniline (Diuron degradate)	Imazethapyr (New Path, Pursuit)	Prometryn (Cotton-pro)
Bendiocarb (Ficam, Garrox, Turcam)	Dichlorprop (Weedone, Polymone)	Imidacloprid (Admire, Provado)	Propanil (Stamp)
Benfluralin (Balan, Benefin)	Dichlorvos (DDVP)	Iprodione (Kidan)	Propargite (Comite, Omite)
Benomyl (Benlate, Benex)	Dicrotophos (Bidrin)	Isofenphos (Oftanol, Lighter)	Propham (Chem Hoe)
Bensulfuron-methyl (Escuri, Londax)	Dieldrin (Panoram D-31, Octalox)	lambda-Cyhalothrin (Charge, Karate)	Propiconazole (Banner)
Bentazon (Basagram, Bentzone)	2,6-Diethylaniline (alachlor degradate)	Linuron (Linurex, Lorox)	cis-Propiconazole (Banner)
Bromacil (Hyvar X)	Dimethoate (Trounce)	Malaoxon (malathion degradate)	trans-Propiconazole (Banner)
Bromoxynil (Buctril, Brominal, Agristar)	Dinoseb (Premerge)	Malathion (Cythion, Malaspray)	Propoxur (Baygone, Suncide)
Carbaryl (Carbatox, Sevin)	Diphenamid (Dymid, Enide)	MCPA (Solve, MCP)	Propyzamide (Kerb)
Carbofuran (Furadan, Futura)	Disulfoton (Di-Syston)	MCPB (Butoxone M40, Thistrol)	Siduron (Tupersan)
Chloramben, methyl ester (Chloramben)	Disulfoton sulfone (disulfoton degradate)	Metalaxyl (Apron, Ridamil, Subdue)	Simazine (Aquazine, Princep)
Chlordiamino-s-triazine {CAAT} (Atrazine degradate)[3]	Diuron (Durashield, Karmex)	Methidathion (Supra)	Sulfometuron-methyl (Oust)
Chlorimuron-ethyl (Classic, Darban, Lory)	alpha-Endosulfan (Thiodan, Tiovel)	Methiocarb (Mesurol)	2,4,5-T
2-Chloro-2,6-diethylacetanilide (alachlor degradate)	Endosulfan sulfate (alpha-endosulfan degradate)	Methomyl (Lannate, Nudrin)	Tebuconazole (Elite)
2-Chloro-4-isopropylamino-6-amino-s-triazine {CIAT} (atrazine degradate)	EPTC (Eptam, Eradicane)	Metolachlor (Bicep, Dual)	Tebuthiuron (Graslan, Spike)
2-Chloro-6-ethylamino-4-amino-s-triazine {CEAT} (atrazine degradate)	Ethion (Ethanox, Rhodocide)	Metribuzin (Lexone, Sencor)	Tefluthrin (Force)
4-Chloro-2-methylphenol (MCPA degradate)	Ethoprophos (Mocap, Prophos)	Metsulfuron methyl (Ally, Escort)	Terbacil (Sinbar, Herbicide 732)
3(4-Chlorophenyl)-1-methyl urea (diuron degradate)	2-Ethyl-6-methylaniline (metalachlor degradate)	Molinate (Hydram, Ordram)	Terbufos (Counter, Contraven)
Chlorpyrifos (Dursban, Lorsban)	Fenamiphos	Myclobutanil (Eagle, Nova)	Terbuthylazine (Gardoprim)
Clopyralid (Stinger, Lontrel)	Fenamiphos sulfone (fenamiphos degradate)	1-Naphthol (carbaryl degradate)	Thiobencarb (Bolero, Saturn)
Cyanazine (Bladex)	Fenamiphos sulfoxide (fenamiphos degradate)	Neburon (Granurex, Propuron)	Tribufos (DEF 6)
Cycloate (Ro-Neet)	Fenuron	Nicosulfuron (Accent, OneHope)	Triclopyr (Garlon)
Cyfluthrin (Decathlon)	Fipronil (Regent)	Norflurazon (Zorial, Solicam)	Trifluralin (Treflan, Trim)
Cypermethrin	Fipronil sulfide (fipronil degradate)	Oryzalin (Surflan)	

[1]The use of trade, product, industry, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government or the Wyoming State Government.

[2]Pesticide or degradate not analyzed for in 2006.

[3]Pesticide or degradate not analyzed for in 2009–10.

USGS National Water Quality Laboratory in Lakewood, Colorado, and to the USGS Organic Geochemistry Research Laboratory in Lawrence, Kansas. The two laboratories analyzed for 134 different pesticides and degradates (compounds that result from pesticides breaking down) in the samples collected during 2009–10 (table 1; Furlong and others, 2001; Sandstrom and others, 2001; Zimmerman and others, 2001).

Pesticide Occurrence

Complete analytical results from all samples collected can be found at *http://nwis.waterdata.usgs.gov/wy/nwis/qwdata* using the site numbers shown on figure 1. Twenty-eight different pesticides or degradates were detected in 2009–10 (table 1); however, all concentrations were much less than associated drinking-water standards (table 2). In comparison to pesticide results from samples collected in 2006, 12 compounds were detected in samples collected in 2009–10 that were not detected in 2006, whereas 4 compounds detected in 2006 were not detected in samples collected in 2009–10 (table 1). An additional two compounds that were not analyzed for in the 2006 samples were detected in the 2009–10 samples, and one compound detected in 2006 samples was not analyzed for in 2009–10 samples because of changes in the analytical schedules by the laboratory.

At least one pesticide or degradate was detected in samples collected from five of the sites in 2009 and from all six sites in 2010 (fig. 2). All sites had a larger number of pesticides detected in the mid-spring samples (2010) compared the late summer samples (2009).

Most pesticides or degradates detected during the 2009 and 2010 sampling were herbicides or their degradates (table 2). Two insecticides and one fungicide also were detected. The most commonly detected compound was the glyphosate degradate, aminomethylphosphonic acid, which was found in 75 percent of all samples (fig. 3).

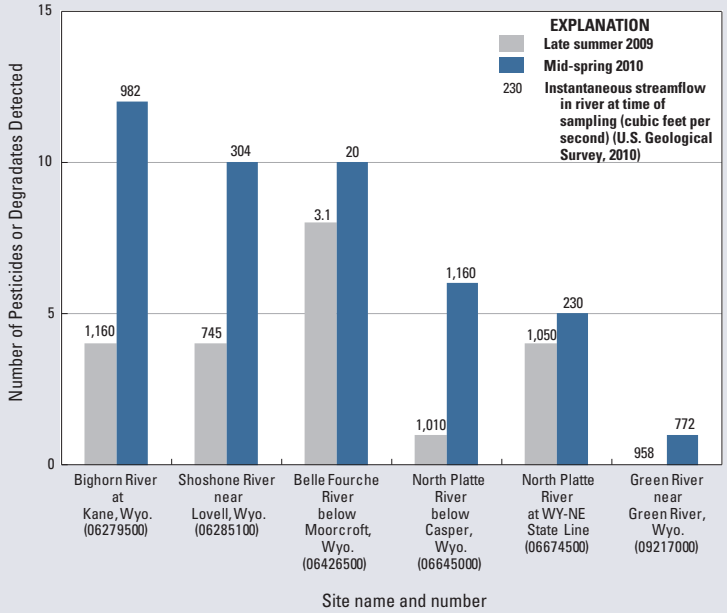

Figure 2. A larger number of pesticides were detected in samples collected in the mid-spring than in the late summer at all sites.

Table 2. All concentrations of detected pesticides in 2009–10 were less than any associated drinking-water standard. Pesticides and degradates (in italics) are shown in color to represent type of pesticide: dark green, herbicide; light green, herbicide degradates; blue, fungicide; orange, insecticide; light orange, insecticide degradate.

[USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; --, not established]

Detected pesticide or degradate	Maximum concentration detected during 2009–10 sampling (µg/L)	USEPA standard or health advisory level (µg/L)
Aldicarb	0.01	[1]3 (MCL)
Aldicarb sulfoxide	0.074	[1]4 (MCL)
Atrazine	0.028	[1]3 (MCL)
2-Chloro-4-isopropylamino-6-amino-s-triazine	0.018	--
2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine	0.006	--
Benfluralin	0.009	--
Benomyl	0.063	--
Bentazon	0.01	[2]200 (LHA)
Chloramben[3]	--	[2]100 (LHA)
3,4-Dichloroaniline	0.024	--
2,4-D	0.12	[1]70 (MCL)
2,4-DB	0.01	--
Diuron	0.19	[4]200 (RSD4)
EPTC	0.036	--
Fipronil	0.004	--
Desulfinylfipronil	0.008	--
Glyphosate	0.16	[1]700 (MCL)
Aminomethylphosphonic acid	0.27	--
Hexazinone	0.027	[2]400 (LHA)
Malathion	0.015	[2]100 (LHA)
MCPA	0.04	[2]30 (LHA)
4-Chloro-2-methylphenol	0.006	--
Metalaxyl	0.01	--
Metolachlor	0.011	[2]700 (LHA)
Metribuzin	0.02	[2]70 (LHA)
Pendimethalin	0.016	--
Prometon	0.07	[2]100 (LHA)
Sulfometuron-methyl	0.004	--
Trifluralin	0.007	[2]10 (LHA)

[1] MCL, USEPA Maximum Contaminant Level (U.S. Environmental Protection Agency, 2006).

[2] LHA, USEPA Lifetime Health Advisory Level (U.S. Environmental Protection Agency, 2006).

[3] Chloramben was not detected, however, it is the parent compound for 3,4-dichloroaniline, and is included in the table for clarification.

[4] RSD4, USEPA Risk-Specific Dose at 10^{-4} Cancer Risk (U.S. Environmental Protection Agency, 2006).

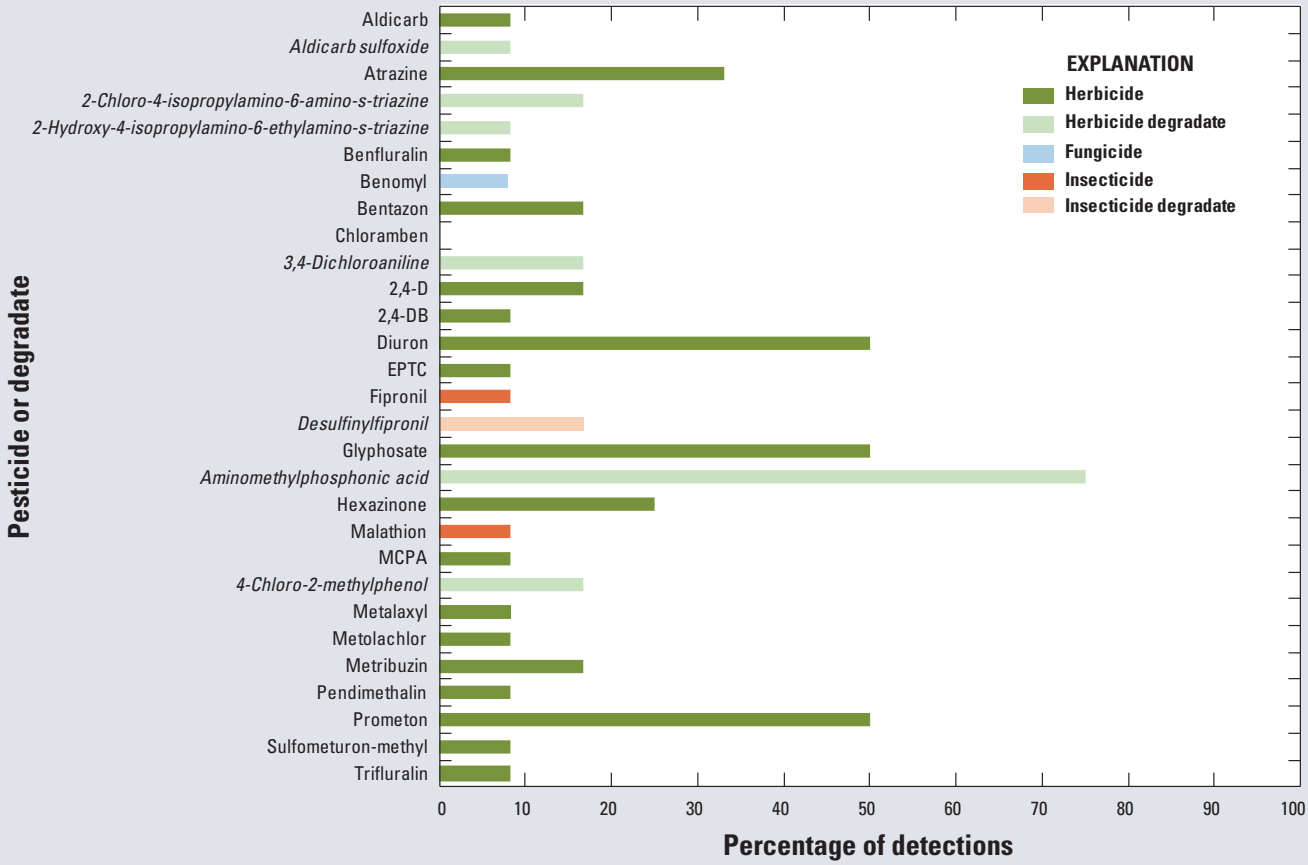

Figure 3. Seventy-five percent of the 12 samples collected in 2009–10 had a detection of a glyphosate degradate. Chloramben was not detected, however, it is the parent compound for 3,4-dichloroaniline, and is included in the figure for clarification.

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For More Information:

Visit the USGS Wyoming Water Science Center Web site at *http://wy.water.usgs.gov/projects/pesticide/index.htm*, or contact:

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