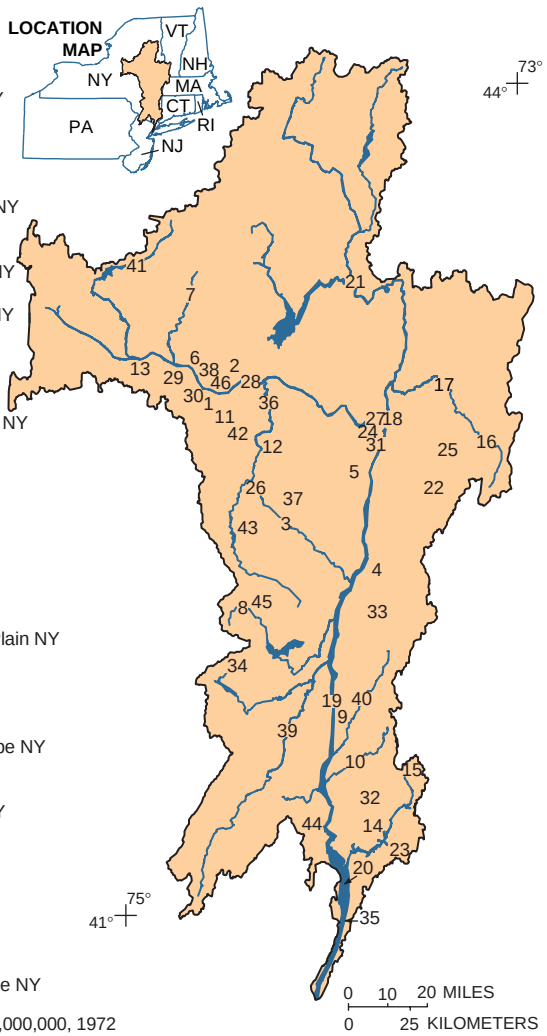
Pesticides in Surface Waters of the Hudson River Basin, New York and Adjacent States

Introduction and Basin Description

The National Water Quality Assessment (NAWQA) program is designed to describe the status and trends in the water quality of large representative parts of the Nation's surface-water and ground-water resources and to provide a scientific understanding of the major natural and human factors that affect the quality of these resources. The Hudson River Basin, one of 60 NAWQA project areas, encompasses 13,400 mi^2 (square miles) in New York and adjacent states. About 78 percent of the basin is forested land, 14 percent agricultural, and 8 percent is urban/residential land. Water samples collected from streams and rivers in the Hudson River Basin in 1994 were analyzed for a broad suite of pesticides, which included herbicides and insecticides. Herbicides are used to control weeds in agricultural fields as well as lawns, commercial land, and other open areas in urban and residential settings. Insecticides are used to control insects in agricultural and urban settings. Because some pesticides can migrate from applied areas to streams and rivers, monitoring surface water for pesticides is necessary to ensure a safe drinking-water supply and the ecological health of streams. This fact sheet summarizes results of a study of pesticides in surface waters of the Hudson River Basin.

1 - Canajoharie Creek near Canajoharie NY
2 - Caroga Creek at Palantine Church NY
3 - Catskill Creek at Oak Hill NY
4 - Claverack Creek at Claverack NY
5 - Coeymans Creek near South Bethlehem NY
6 - Crum Creek at East Creek NY
7 - East Canada Creek at Stratford NY
8 - Esopus Creek at Allaben NY
9 - Fall Kill at Poughkeepsie NY
10 - Fishkill Cr at Stormville Rd nr Hopewell Jct NY
11 - Flat Creek near Ames NY
12 - Fox Creek near Schoharie NY
13 - Fulmer Creek at Days Rock near Mohawk NY
14 - Hallocks Mill Brook at Yorktown Heights NY
15 - Haviland Hollow Brook near Putnam Lake NY
16 - Hoosic River below Williamstown MA
17 - Hoosic River near Eagle Bridge NY
18 - Hudson River at Waterford NY
19 - Hudson River near Poughkeepsie NY
20 - Hudson River south of Hastings-on-Hudson NY
21 - Hudson River south of Lake Luzerne NY
22 - Kinderhook Creek at East Nassau NY
23 - Kisco River below Mount Kisco NY
24 - Lisha Kill northwest of Niskayuna NY
25 - Little Hoosic River at Petersburg NY
26 - Little Schoharie Creek at Middleburgh NY
27 - Mohawk River at Cohoes NY
28 - Mohawk River at Fonda NY
29 - Nowadaga Creek at Newville NY
30 - Otsquago Creek at Valley Brook near Fort Plain NY
31 - Patroon Creek at Albany NY
32 - Peekskill Hollow Cr at Van Cortlandtville NY
33 - Roeliff Jansen Kill at Jackson Corners NY
34 - Rondout Creek near Sundown NY
35 - Saw Mill River at Farragut Ave at Mount Hope NY
36 - Schoharie Creek at Esperance NY
37 - Tenmile Creek at Medusa NY
38 - Timmerman Creek at West St. Johnsville NY
39 - Wallkill River at Gardiner NY
40 - Wappinger Creek near Clinton Corners NY
41 - West Canada Creek at Nobleboro NY
42 - West Creek at Warnersville NY
43 - West Kill northwest of North Blenheim NY
44 - Woodbury Creek near Highland Mills NY
45 - Woodland Creek at Mouth at Phoenicia NY
46 - Zimmerman Creek northeast of St. Johnsville NY



Base from U.S. Geological Survey digital data 1:2,000,000, 1972

Figure 1. Pesticide-sampling locations in Hudson River Basin

Pesticide Sampling

Water samples were collected from a basinwide network of 46 sites on 42 streams and rivers (fig. 1) during base-flow conditions from late May through late June 1994, when pesticides are commonly applied to fields. Sites were classified into one of the following categories on the basis of predominant land use and population in the watershed above the site: (1) urban – watersheds with a population density greater than 200 per mi^2; (2) agricultural – watersheds that are more than 35 percent agricultural land; (3) forested – watersheds that are more than 90 percent forested; and (4) mixed – watersheds that are less than 35 percent agricultural, have a population density of less than 200 per mi^2, and are less than 90 percent forested. The mixed category includes sites that represent most of the large watersheds sampled; 9 of 16 sites in this category represent watersheds larger than 500 mi^2, and the other 7 sites are in watersheds smaller than 250 mi^2.

Results

Of the 46 sites sampled within the basin, 85 percent had detectable concentrations of at least one pesticide, but only four sites had detectable concentrations of more than five pesticides. The Mohawk River at Cohoes had measurable amounts of eight pesticides or pesticide-breakdown products (metabolites), and Hoosic River at Eagle Bridge had measurable amounts of six. Both sites are in watersheds classified as mixed. Lisha Kill at Niskayuna and West Creek at Warnersville (in urban and agricultural watersheds, respectively) each had 5 detectable pesticides and 1 detectable herbicide metabolite. Among the 46 sites sampled, 15 different pesticides were detected – 8 herbicides, 2 herbicide metabolites, and 5 insecticides (table 1). Most of the pesticides were at low concentrations, ranging from 0.002 to 0.05 µg/L (micrograms per liter).

Table 1. Pesticides detected in the Hudson River Basin during June 1994 basinwide pesticide sampling[1]

Pesticide[2] (brown - herbicide, light brown - herbicide metabolite, green - insecticide)	Trade name(s)	Percent of sites with detection	Detection limit (µg/L)	Median concentration of detections (µg/L)	Maximum concentration detected (µg/L)	Maximum contaminant level (MCL) or Health advisory (HA)[3] (µg/L)
Atrazine	AAtrex, Crisazina	85	0.002	0.015	0.38	3
Metolachlor	Dual, Pennant	67	0.002	0.012	0.16	100
Deethylatrazine[4]	none	52	0.002	0.006	0.041	--
Diazinon	D.z.n, Sarolex	30	0.002	0.0075	0.056	0.6
Simazine	Caliber, Princep	28	0.005	0.013	0.55	4
Cyanazine	Bladex	17	0.004	0.0295	0.2	1
Alachlor	Lasso, Bullet	9	0.002	0.013	0.022	2
Carbaryl	Sevin	7	0.003	0.044	1.6	700
DCPA	Dacthal	4	0.002	0.01	0.011	400
Prometon	Pramitol	4	0.018	0.0225	0.024	100
Pronamide	Kerb	2	0.003	0.052	0.052	50
Carbofuran	Furacarb	2	0.003	0.021	0.021	40
Chlorpyrifos	Genpest, Eradex	2	0.004	0.01	0.01	20
Malathion	Cythion	2	0.005	0.1	0.1	200
2,6-Diethylanaline[5]	none	2	0.003	0.003	0.003	--

[1]For a complete list of pesticide analytes, refer to Firda and others (1994).

[2]Use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

[3]MCL - Maximum permissible level of a contaminant in water which is delivered to any user of a public water system; HA - Concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure.

[4] Deethylatrazine is a metabolite of both atrazine and simazine.

[5] 2,6-Diethylanaline is a metabolite of alachlor.

The maximum concentration of any pesticide detected was less than 2 µg/L, and no concentration exceeded any maximum contaminant level or health advisory level set by the U.S. Environmental Protection Agency.

The most frequently detected pesticides were atrazine[1] and metolachlor, which are widely used for weed control on corn, sorghum, and certain other crops; they were found at 85 and 67 percent of the 46 sites, respectively, and were found together at 67 percent of the sites. Atrazine was found at all sites at which any pesticide was detected. Eight of the nine sites without atrazine detection were in forested or urban watersheds; the ninth was at West Kill, northwest of North Blenheim, in a small mixed watershed.

The sites in urban watersheds had the same number of pesticides as sites in the agricultural and mixed watersheds – nine pesticides in each of these groups (table 2). The types of pesticides at a given site correlated closely with land use – 32 percent of all pesticides detected at urban-watershed sites were insecticides, whereas only 9 percent of those detected at agricultural and mixed sites were insecticides. Of the pesticides detected among all 46 sites, 50 percent were at urban-watershed sites. Four of the 15 pesticides detected (carbaryl, DCPA, prometon, and malathion) were found only at urban-watershed sites.

Pesticides were detected at only 2 of the 6 forested watershed sites. Four pesticides (atrazine, metolachlor, deethylatrazine, and cyanazine) were found at West Canada Creek at Nobleboro at concentrations less than or equal to 0.012 µg/L, and atrazine and metolachlor were detected at East Canada Creek at Stratford at concentrations equal to or less than 0.007 µg/L. Atrazine and other herbicides are not commonly used in forested areas; thus, their presence could be the result of atmospheric transport from areas in which pesticides are applied.

The diversity of land use in some of the mixed watersheds could explain the large number of pesticides and herbicides detected because some of these watersheds contain both agricultural and urban land. For example, the Mohawk River at Cohoes, a mixed watershed, drains more than 3,500 mi^2 and has a substantial amount of agricultural land (33 percent of watershed area) and urban land (7 percent of watershed area). The sample

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

Table 2. Pesticide detections and watershed land-use category

Watershed land-use category and number of sites	Number of pesticides identified	Number of detections	Percentage of detections as herbicide/ metabolite/ insecticide	Number of pesticides identified at a site	
				Maximum	Minimum
Urban (10)	9	31	61/7/32	6	0
Agricultural (14)	9	53	68/23/9	6	2
Mixed (16)	9	54	72/19/9	8	0
Forested (6)	4	6	83/17/0	4	0

Table 3. Concentrations of pesticides detected in surface water at 46 sites in the Hudson River Basin, May-June 1994

Site[1]	Basin Area (square miles)	Concentration, in micrograms per liter														
		Atrazine	Metolachlor	Deethylatrazine	Diazinon	Simazine	Cyanazine	Alachlor	Carbaryl	DCPA	Prometon	Pronamide	Carbofuran	Chlorpyrifos	Malathion	2,6-Diethylanaline
1	60	0.38	0.16	0.041	nd	nd	0.20	nd	nd	nd	nd	nd	nd	nd	nd	nd
2	89	0.039	0.009	0.006	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3	80	0.005	nd	0.002	0.009	0.013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4	55	0.014	0.013	0.007	nd	0.013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
5	34	0.013	nd	nd	0.007	nd	nd	nd	nd	nd	nd	nd	0.021	nd	nd	nd
6	16	0.027	miss	0.007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
7	104	0.007	0.003	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
8	64	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9	19	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
10	55	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
11	47	0.055	0.042	0.023	nd	0.009	0.094	nd	nd	nd	nd	nd	nd	nd	nd	nd
12	99	0.11	0.03	0.006	nd	nd	0.12	nd	nd	nd	nd	nd	nd	nd	nd	nd
13	11	0.022	0.004	0.012	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
14	11	0.008	0.005	nd	0.011	nd	nd	nd	nd	nd	0.021	nd	nd	nd	nd	nd
15	12	0.008	0.004	0.004	0.006	0.55	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
16	205	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
17	511	0.075	0.011	0.01	nd	0.011	0.011	0.022	nd	nd	nd	nd	nd	nd	nd	nd
18	4,625	0.014	0.014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
19	11,926	0.015	0.014	nd	nd	0.007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
20	13,347	0.008	0.003	nd	nd	0.006	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
21	2,713	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
22	114	0.013	0.004	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
23	18	0.005	nd	nd	0.006	0.052	nd	nd	0.014	0.008	nd	nd	nd	nd	nd	nd
24	15	0.014	0.007	0.002	0.039	nd	nd	nd	0.044	nd	0.024	nd	nd	nd	nd	nd
25	54	0.013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
26	25	0.017	0.015	0.003	0.007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
27	3,519	0.049	0.031	0.005	0.007	0.011	0.017	0.006	nd	nd	nd	nd	nd	nd	nd	0.003
28	2,188	0.029	0.02	nd	0.048	nd	nd	nd	nd	nd	nd	0.052	nd	nd	nd	nd
29	22	0.024	0.016	0.012	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
30	58	0.052	0.019	0.022	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
31	14	0.015	0.011	0.005	0.056	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
32	48	0.006	0.005	nd	0.017	0.014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
33	170	0.26	0.14	0.017	nd	0.11	nd	0.016	nd	nd	nd	nd	nd	nd	nd	nd
34	17	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
35	21	0.017	nd	nd	nd	0.011	nd	nd	1.60	0.011	nd	nd	nd	nd	0.1	nd
36	875	0.021	0.024	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
37	18	0.008	0.006	0.002	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
38	15	0.016	0.005	0.007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
39	735	0.043	0.12	nd	nd	0.27	0.016	nd	nd	nd	nd	nd	nd	0.01	nd	nd
40	90	0.009	nd	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
41	191	0.009	0.005	0.003	nd	nd	0.012	nd	nd	nd	nd	nd	nd	nd	nd	nd
42	52	0.055	0.04	0.009	0.005	nd	0.042	0.01	nd	nd	nd	nd	nd	nd	nd	nd
43	38	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
44	11	0.004	nd	nd	0.008	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
45	21	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
46	13	0.013	0.004	0.003	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

[1] Locations are shown in figure 1.

Red - urban/residential, orange - agricultural, yellow - mixed, green - forested, nd - not detected, miss - missing data

from this site contained 5 herbicides, 2 herbicide metabolites, and 1 insecticide.

The correlation between pesticides and land use can be seen in the concentrations, as well as the types, of pesticides detected. For example, atrazine and metolachlor concentrations were highest in agricultural watersheds (fig. 2); 21 percent and 14 percent of atrazine and metolachlor detections, respectively, in agricultural watershed sites were at concentrations above 0.1 µg/L. No sites in the other watershed categories had atrazine or metolachlor concentrations above 0.075 and 0.031 µg/L respectively. Of all detections at forested, urban, and mixed watershed sites, only two were at a concentration above 0.1 µg/L.

The insecticide diazinon was detected most frequently and at highest concentrations at urban-watershed sites. Concentrations at 40 percent of these sites were above 0.01 µg/L, compared to only 6 percent of those at mixed-watershed sites and none at agricultural and forested-watershed sites. The highest concentration of diazinon (0.056 µg/L) was in Patroon Creek at Albany.

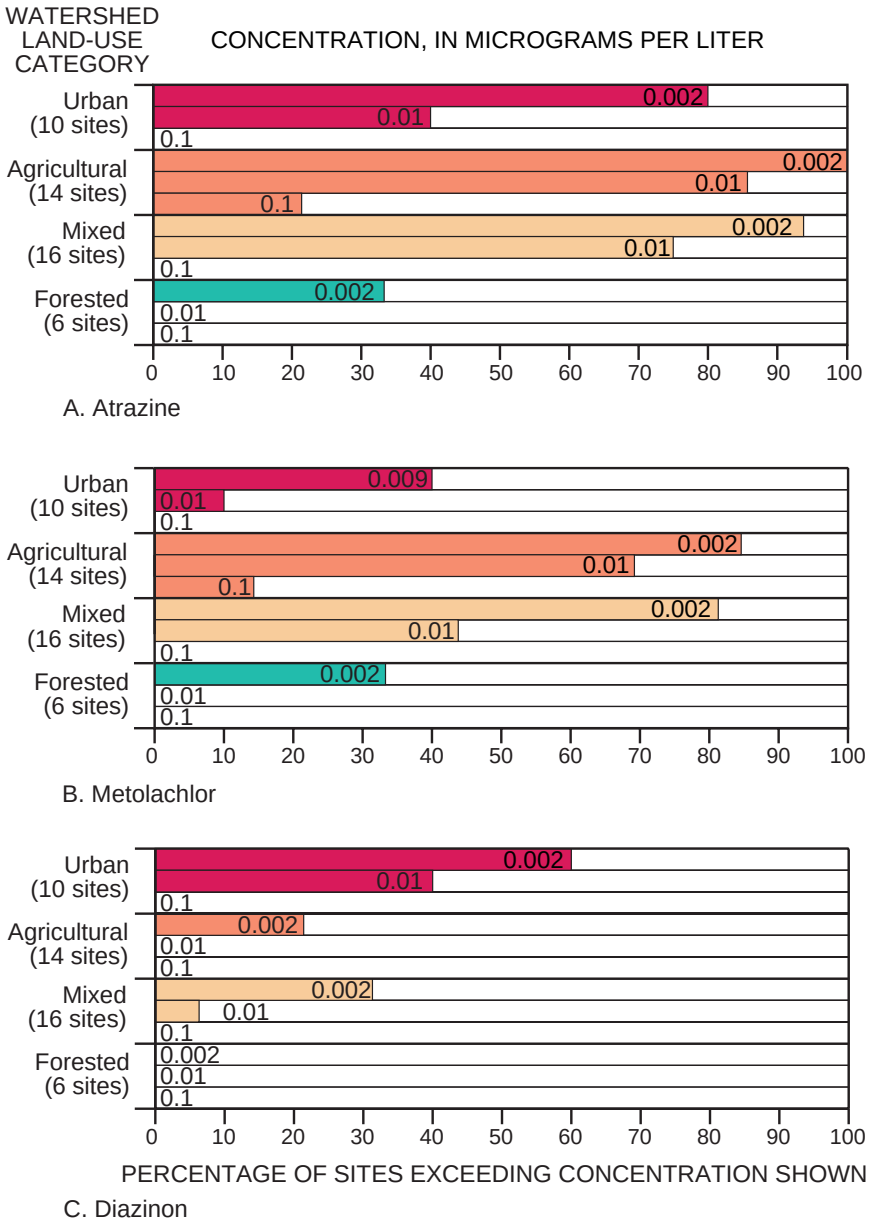


Figure 2. Concentrations of selected pesticides by land use category

Summary

Analyses of water samples collected at 46 sites on 42 streams and rivers in the Hudson River Basin during base-flow conditions in May and June 1994 suggest that pesticide occurrence is related to land use. Herbicides such as atrazine and metolachlor were detected most frequently in watersheds that are predominantly agricultural, and insecticides such as diazinon were detected most frequently in watersheds that are predominantly urban. Pesticide concentrations in samples collected in this study were generally low, and ranged from detection limits (generally around 0.002 µg/L) to less than 0.1 µg/L; no samples had concentrations above any maximum contaminant level or health advisory level set by the U.S. Environmental Protection Agency.

—Gary R. Wall and Patrick J. Phillips

Reference Cited

Firda, G.D., Lumia, R., Murray, P.M., and Freeman, W.O., 1994, U.S. Geological Survey Water-Data Report NY-94-1.

For more information contact:

Hudson River NAWQA Project Chief
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180

This fact sheet and related information can be found on the World Wide Web at: http://ny.usgs.gov

Additional earth science information can be obtained by accessing the USGS "Home Page" on the World Wide Web at: http://water.usgs.gov