PESTICIDES IN THE HUDSON RIVER BASIN, 1994-96

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ABSTRACT: The occurrence, distribution, and temporal patterns of pesticide concentrations were studied in the Hudson River Basin during 1994 - 96. This article presents the results of three separate pesticide studies conducted as part of the U.S. Geological Survey (USGS) National Water Quality Assessment (NAWQA) program.

Pesticides were found in all three studies, but rarely at concentrations exceeding any U.S. Environmental Protection Agency drinking-water standards. The highest concentrations were detected during and immediately after the first runoff following pesticide applications in the late spring and early summer. The herbicides atrazine and metolachlor were the most commonly detected pesticides and were present in nearly every sample collected from streams draining agricultural areas; they also were detected in many streams draining areas with other land uses. Herbicides were most often detected, and had the highest concentrations, in samples from streams draining agricultural areas, whereas insecticides such as diazinon were most commonly detected, and had the highest concentrations, in samples from streams draining urban areas.

INTRODUCTION

A primary objective of the USGS National Water Quality Assessment (NAWQA) program is to describe the status and trends in the quality of representative parts of the Nation's surface-water resources and to describe the major natural and human-derived factors that affect the quality of these resources. The Hudson River Basin is one of 60 NAWQA study areas. It encompasses 13,400 mi² in New York and adjacent States (Fig. 1). About 78 percent of the basin is forested, 14 percent is agricultural, and 8 percent is urban/residential.

This article presents results of (1) A basinwide survey of pesticide concentrations at 46 sites on 41 streams and rivers within the Hudson River Basin; (2) a study of pesticide concentrations and their temporal variability in three streams in the Mohawk River subbasin; and (3) a study of the variability in pesticide concentrations during storms at Canajoharie Creek, which drains a small agricultural watershed in the Mohawk River basin.

The basinwide survey entailed collection of water samples from the 46 sites on streams and rivers (Fig. 2) during base-flow conditions from late May through late June 1994, the period in which pesticides are commonly applied to fields. Sites were classified into one of four categories on the basis of predominant land use and (or) population in the watershed above the site, as indicated in Table 1. The mixed land-use category includes most of the streams and rivers draining large watersheds. Of the 16 sites in this category, 9 represent watersheds larger than 500 mi²; the other 7 are in watersheds smaller than 250 mi².

The second study entailed pesticide sampling at three streams in the Mohawk River subbasin from March 1994 through September 1995. This subbasin encompasses 3,519 mi² and represents about 25 percent of the Hudson River Basin. About 55 percent of the Mohawk subbasin is forested, 33 percent is agricultural, 7 percent is urban/residential, and 5 percent is wetland, water, or other land cover. The diverse land use within this large subbasin makes it a probable major contributor of several pesticides to the Hudson River. The

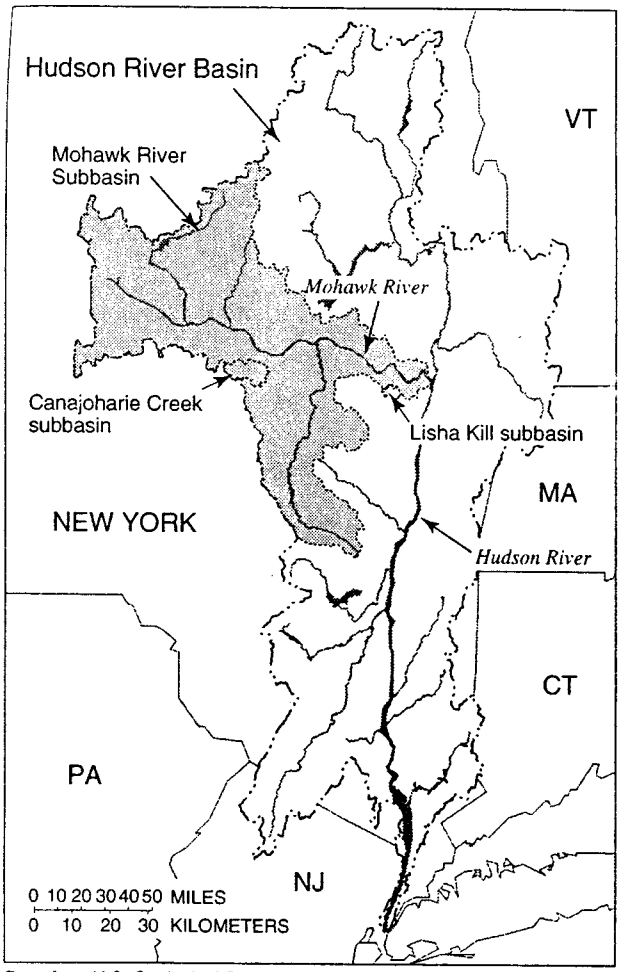

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Figure 1. Hudson River Basin and locations of subbasins studied.

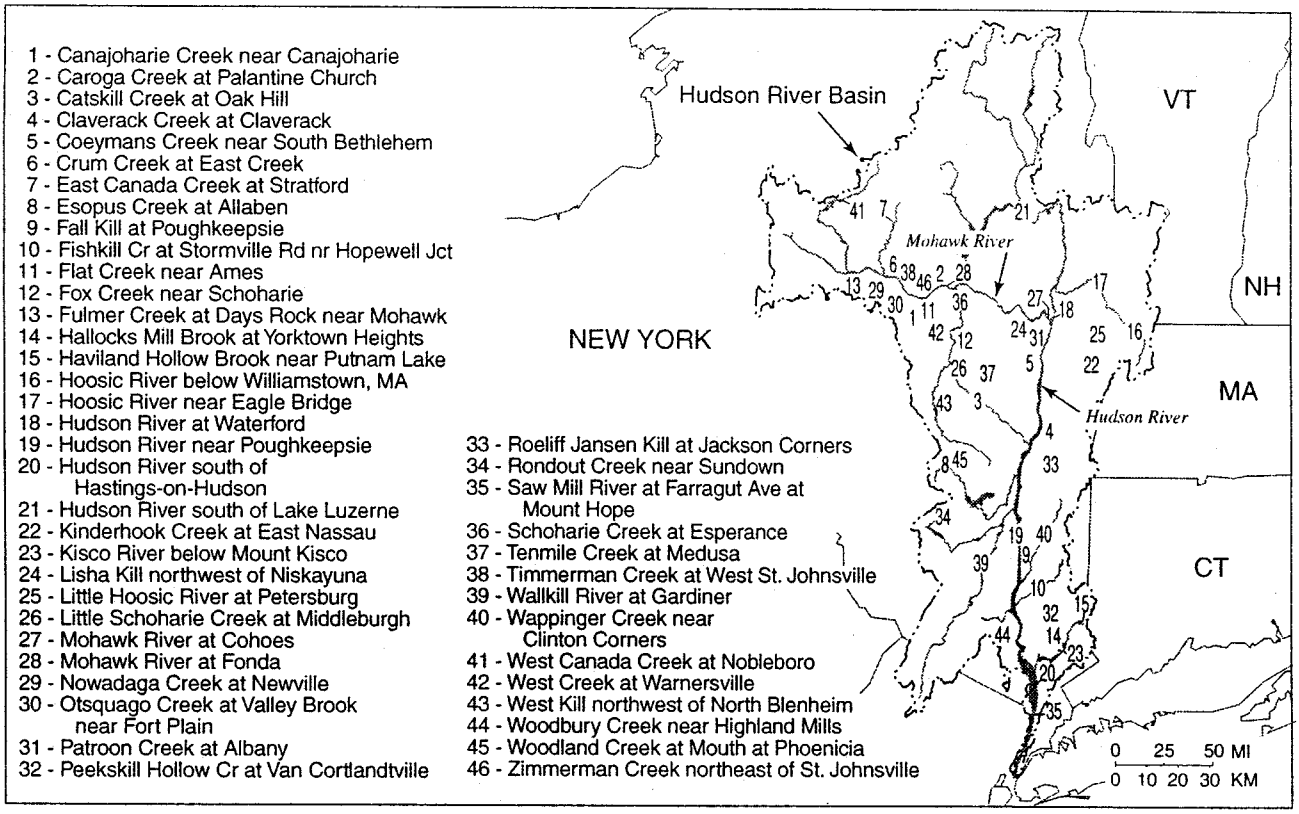

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Figure 2. Locations of pesticide-sampling sites in the 1994 basinwide survey.

Table 1. Land-use classification for studies of pesticides in streams of the Hudson River Basin, 1994-96.

Land-use category	Watershed criteria
Urban	Population density ≥ 200/mi^2
Agricultural	> 35 percent is agricultural
Forested	> 90 percent is forested
Mixed	< 35 percent is agricultural, population density < 200/mi^2, < 90 percent is forested

objective of this study was to document the variability of pesticide concentrations with respect to season, streamflow conditions, and land use.

The three streams sampled in the Mohawk River subbasin included (1) Canajoharie Creek, which drains a 60-mi^2 watershed, 66 percent of which is agricultural, (2) Lisha Kill, which drains a 15-mi^2 watershed, 56 percent of which is urban land, and (3) the Mohawk River at Cohoes (the mouth of the Mohawk River), which drains a combination of urban, forested, and agricultural land. Locations are shown in figure 1.

The third study entailed sampling of Canajoharie Creek over the duration of a storm in June 1996 to estimate peak pesticide concentrations and loads during the application period and to compare results with data collected during 1994-96 as part of the Mohawk River subbasin study. This creek was selected for study because (1) the percentage of agricultural land in the watershed is typical of that found within 15 mi of the Mohawk River (the largest tributary to the Hudson River) and (2) the occurrence of pesticides in Canajoharie Creek is considered representative of that in other agricultural watersheds in the Mohawk River subbasin (Wall and Phillips 1996). Canajoharie Creek was sampled at its mouth (Figs. 1 and 2) weekly or monthly from March 1994 through March 1996 and was sampled eight times during June 7-11, 1996, during the first storm-runoff period after pesticide application. Two samples were collected during the previous 2 years (July 1, 1994 and June 3, 1995) under similar runoff conditions.

Samples in each of the three studies described here were collected and filtered in accordance with methods described by Shelton (1994) and analyzed for 47 pesticides (listed in Firda and others 1994), which included herbicides and insecticides, through methods described by Zaugg and others (1995). Method detection limits for the pesticides analyzed ranged from 0.001 to 0.018 µg/L.

Table 2. Names, concentrations, and other data on pesticides detected in water samples collected from 46 sites on 42 streams throughout Hudson River Basin in June 1994.

[µg/L, micrograms per liter. EPA, U.S. Environmental Protection Agency. Sampling locations are shown in fig. 2.]

Pesticide	Pesticide use	Trade name(s)[1]	Detection limit (µg/L)	Sites with detection		Concentration (µg/L)		EPA limit (MCL or HA)[2] (µg/L)
				Number	Percent	Median of detections	Maximum	
Atrazine	Herbicide	AAtrex, Crisazina	0.001	39	85	0.015	0.38	3
Metolachlor	Herbicide	Dual, Pennant	0.002	30	67	0.012	0.16	100
Deethylatrazine	Degradation product	none	0.002	24	52	0.006	0.041	--
Diazinon	Insecticide	D.z.n, Sarolex	0.002	14	30	0.0075	0.056	0.6
Simazine	Herbicide	Caliber, Princep	0.005	13	28	0.013	0.55	4
Cyanazine	Herbicide	Bladex	0.004	8	17	0.0295	0.2	1
Alachlor	Herbicide	Lasso, Bullet	0.002	4	9	0.013	0.022	2
Carbaryl	Insecticide	Sevin	0.003	3	7	0.044	1.6	700
DCPA	Herbicide	Dacthal	0.002	2	4	0.01	0.011	400
Prometon	Herbicide	Pramitol	0.018	2	4	0.0225	0.024	100
Pronamide	Herbicide	Kerb	0.003	1	2	0.052	0.052	50
Carbofuran	Insecticide	Furacarb	0.003	1	2	0.021	0.021	40
Chlorpyrifos	Insecticide	Genpest, Eradex	0.004	1	2	0.01	0.01	20
Malathion	Insecticide	Cythion	0.005	1	2	0.1	0.1	200
2,6-Diethylanaline	Degradation product	none	0.003	1	2	0.003	0.003	--

[1] Use of trade names is for identification purposes only and does not imply endorsement by the U.S. Government

[2] MCL, Maximum permissible level of a contaminant in water that is delivered to any user of a public water system. HA, Health Advisory Level - concentration of a chemical in drinking water that is not expected to cause any adverse nonncarcinogenic effects over a lifetime of exposure.

The original reports on these studies were published individually (Wall and Phillips 1996a,b; 1997) and are available through the USGS at 425 Jordan Rd., Troy, NY 12180, or on the World Wide Web at *http://ny.usgs.gov*.

RESULTS AND DISCUSSION

Basinwide Survey of May-June 1994

Of all samples from the 46 sites studied in the basinwide survey, 39 (85 percent) had detectable concentrations of at least one pesticide, but those from only four sites had detectable concentrations of more than five pesticides. Samples from the Mohawk River (Cohoes site) had measurable amounts of eight pesticides or pesticide-degradation products, and samples from the Hoosic River (Eagle Bridge site) had measurable amounts of six. Both sites are in watersheds classified as mixed. Samples from Lisha Kill (urban watershed) and West Creek (agricultural watershed) each had 5 detectable pesticides and 1 detectable herbicide-degradation product. Among the 46 sites, 15 pesticides were detected – 8 herbicides, 2 herbicide-degradation products, and 5 insecticides (Table 2). Most of the pesticide concentrations were low — 0.002 to 0.05 µg/L. The maximum concentration of any pesticide detected was less than 2 µg/L, and no concentration exceeded any maximum contaminant level (MCL) or health advisory (HA) level set by the U.S. Environmental Protection Agency (1996).

The most frequently detected pesticides were atrazine and metolachlor, which are widely used for weed control on corn, sorghum, and certain other crops; they were found in samples from 85 and 67 percent of the 46 sites, respectively, and were found together in samples from 67 percent of the sites. Atrazine was found in all samples in 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 (Fig. 2), a small mixed watershed.

Samples from urban watersheds had the same number of pesticides as those from agricultural and mixed watersheds – nine pesticides in each of these groups (Table 3). The types of pesticides at a given site correlated closely with land use – 32 percent of all pesticides detected in samples from urban watersheds were insecticides, whereas only 9 percent of those in samples from agricultural and mixed watersheds were insecticides. Of the 20 insecticide detections in samples from the 46 sites, 50 percent were in samples from urban watersheds. Four of the 15 pesticides detected (carbaryl, DCPA, prometon, and malathion) were found only in samples from urban watersheds.

Pesticides were detected in samples from only 2 of the 6 forested watersheds. The West Canada Creek sample contained four pesticides (atrazine, metolachlor, deethylatrazine, and cyanazine) at concentrations less than or equal to 0.012 µg/L, and the East Canada Creek sample

Table 3. Number and frequency of pesticide detections in Hudson River basin, by land-use category, 1994-96.

[Land-use categories are summarized in table 1]

Land-use category	Number of			Percentage of detections		No. of pesticides identified at a site	
	Sites	Detections	Pesticides	Herbicide[1]	Insecticide[1]	Max.	Min.
Urban	10	31	9	61	32	6	0
Agricultural	14	53	9	68	9	6	2
Mixed	16	54	9	72	9	8	0
Forested	6	64	4	83	0	4	0

[1] Degradation products account for herbicide + insecticide values that do not total 100 percent

contained atrazine and metolachlor 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 in these streams 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 drains a large (3,500 mi²) mixed watershed of which 33 percent is agricultural land and 7 percent is urban land. The sample from this site contained 5 herbicides, 2 herbicide-degradation products, and 1 insecticide.

The correlation between pesticides and land use can be seen in the concentrations, as well as the types, of pesticides detected in the basinwide survey. For example, atrazine and metolachlor concentrations were highest in samples from agricultural watersheds (Fig. 3); 21 percent and 14 percent of atrazine and metolachlor detections, respectively, in samples from agricultural watersheds were at concentrations above 0.1 µg/L. No samples from the other watershed categories contained atrazine or metolachlor in concentrations above 0.075 and 0.031 µg/L, respectively. Of all pesticides detected in samples from forested, urban, and mixed watersheds, only two were at a concentration above 0.1 µg/L.

The insecticide diazinon was detected most frequently and at highest concentrations in samples from urban watersheds. Concentrations above 0.01 µg/L were detected in samples from 40 percent of these sites, as opposed to only 6 percent of samples from mixed-watersheds and none from agricultural or forested watersheds. The highest concentration of diazinon (0.056 µg/L) was in the sample from Patroon Creek at Albany.

Mohawk River Subbasin Study, 1994-95

Samples from the 3 sites in the Mohawk River subbasin contained 18 pesticides (Table 3), including 12 herbicides, 2 herbicide-degradation products, and 4 insecticides. Of the 108 samples collected at the three sites, only two contained any pesticide at a concentration that exceeded the MCL or HA; both samples were from Canajoharie Creek. One sample had an atrazine concentration of 4.3 µg/L, which exceeded the MCL for atrazine. This sample was collected after a runoff-producing storm in July 1994 and represents the largest instantaneous discharge associated with any sample collected

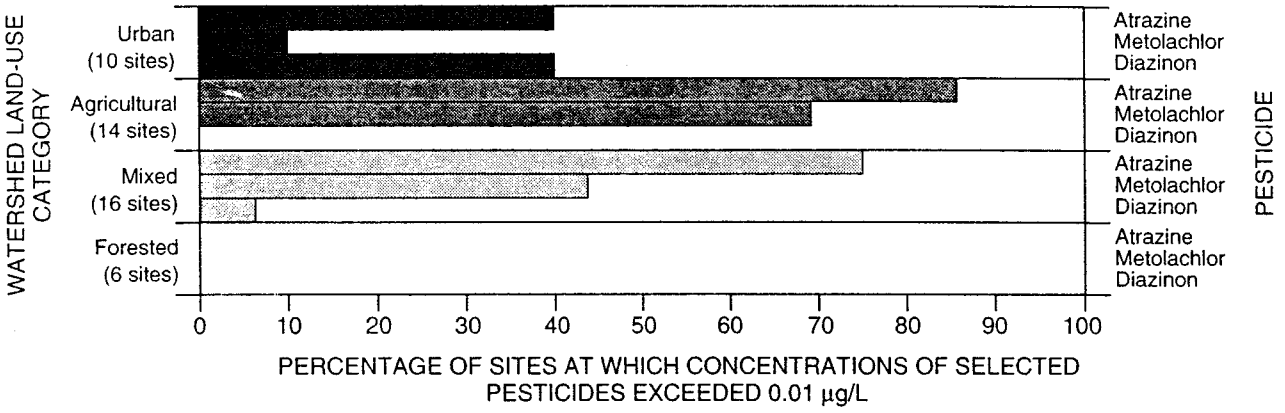


Figure 3. Percentage of sites sampled in the 1994 basinwide survey with concentrations of atrazine, metolachlor, and diazinon, exceeding 0.01 µg/L by watershed land-use category.

at Canajoharie Creek during the growing seasons of 1994 and 1995. The other sample was collected after a smaller storm in June 1995 and had a cyanazine concentration of 2.1 µg/L, which exceeded the HA for cyanazine.

Pesticide Concentrations in Relation to Land Use.-- The highest concentrations of all but three pesticides detected at the three Mohawk subbasin sites were in samples from either Canajoharie Creek or Lisha Kill (Table 4). The exceptions were alachlor (7 detections); 2,6, diethylanaline (3 detections); and tebuthiuron (1 detection). The Mohawk River receives water from many tributaries that drain forested, urban, and agricultural lands. The lower concentrations of pesticides in samples from the Cohoes site than in those from Canajoharie Creek and Lisha Kill, therefore, can be attributed to dilution.

Canajoharie Creek drains areas where agricultural chemicals are applied; therefore, the detection of agricultural pesticides, including atrazine, cyanazine, metolachlor, pendimethalin, metribuzin, and simazine in relatively high concentrations was not surprising. The Lisha Kill watershed, in contrast, contains many urban/residential areas and, as expected, yielded the highest concentrations of all four insecticides that were detected in the Mohawk River subbasin.

Table 4. Names and concentrations of pesticides detected in stream-water samples from the Mohawk River subbasin study, 1994-95.

Pesticides detected	Use[1]	Concentration (micrograms per liter)		
		Detection limit	MCL or HA[2]	Maximum detected
Atrazine	H	0.001	3	4.3
Cyanazine	H	0.004	1	2.1
Metolachlor	H	0.002	100	1.3
Carbaryl	I	0.003	700	0.86
Diazinon	I	0.002	0.6	0.55
Deethylatrazine	DP	0.002	na	0.22
alpha BHC	I	0.002	na	0.21
Prometon	H	0.018	100	0.071
Pendimethalin	H	0.004	na	0.035
Metribuzin	H	0.004	100	0.033
Terbacil	H	0.007	90	0.023
Alachlor	H	0.002	2	0.021
Simazine	H	0.005	4	0.018
Molinate	H	0.004	na	0.016
Tebuthiuron	H	0.01	500	0.01
Chlorpyrifos	I	0.004	20	0.009
EPTC	H	0.002	na	0.004
2,6 - Diethylanaline	DP	0.003	na	0.003

[1] H - herbicide, I - insecticide, DP - degradation product

[2] MCL - Maximum Contaminant Level; HA - Health Advisory Level

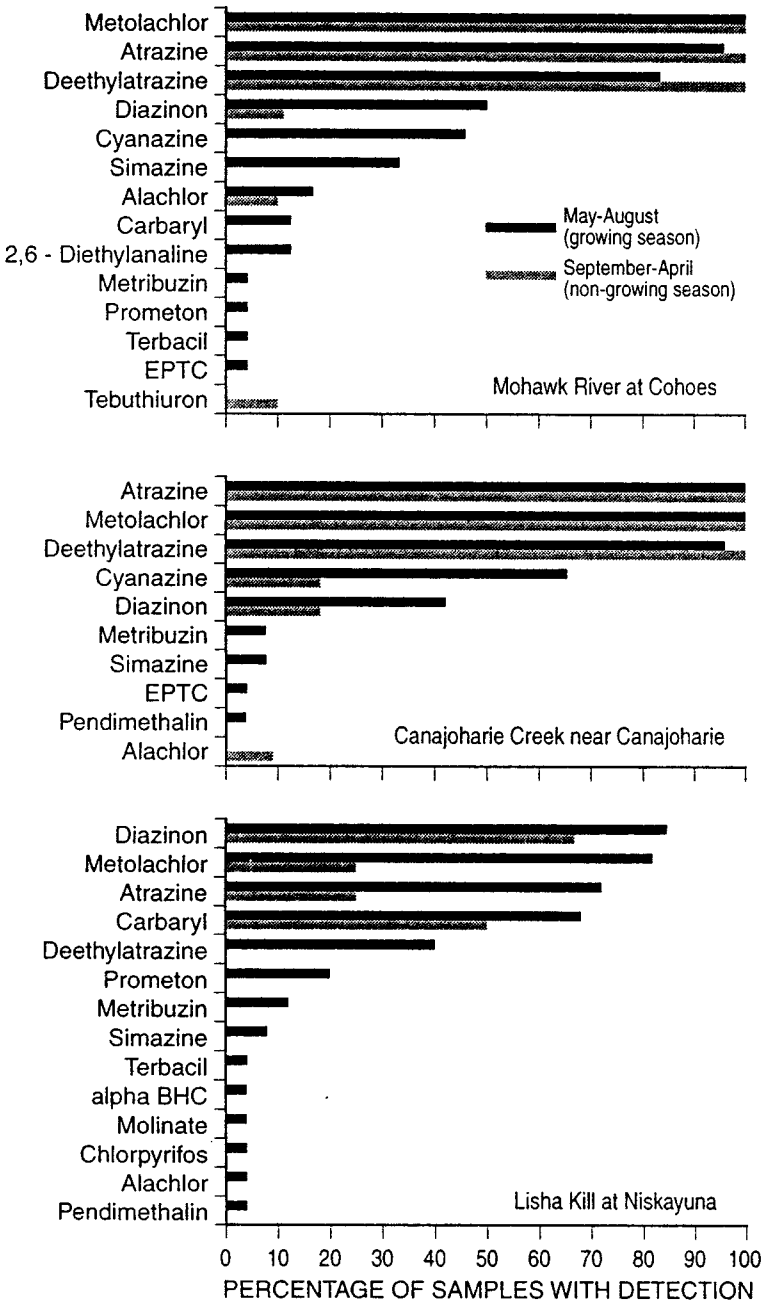
The presence and concentrations of pesticides detected at the three Mohawk River subbasin sites are depicted in figure 4. Metolachlor, atrazine, and deethylatrazine were detected in nearly all samples from the Mohawk River and Canajoharie Creek, but the maximum and median concentrations in Canajoharie Creek were typically greater than those in the Mohawk River. Diazinon was detected most frequently in samples from Lisha Kill and was present in more than 80 percent of samples collected from May through August 1994-95 and in more than 60 percent of samples collected from September through April (Fig. 4). Diazinon is applied almost exclusively in urban/residential areas; thus, its greater frequency of detection and higher concentrations in samples from the Lisha Kill than from the Mohawk River is attributed to the greater proportion of urban/residential land in the Lisha Kill watershed. No samples from Canajoharie Creek, whose watershed is less than 1.5 percent urban/residential, had detectable concentrations of diazinon.

The higher percentage of pesticide detections during the growing season (May through August) than in the nongrowing season (September through April; see Fig. 4) reflects the amount of time since pesticides were applied to fields and urban areas. Most of the pesticides in samples collected during the nongrowing season were probably the result of pesticides which had reached ground water and were subsequently discharged to streams and rivers.

Seasonal Atrazine Patterns.-- Pesticide concentrations in Canajoharie Creek and the Mohawk River at Cohoes peaked during the first major runoff-producing storms after pesticide application. In general, seasonal concentration patterns of pesticides at these sites mimicked those of atrazine (Fig. 5). The highest atrazine concentrations were in samples collected from Canajoharie Creek during June and July, and ranged from 0.04 to more than 1 µg/L. Atrazine concentrations during the remainder of the year generally ranged from 0.02 to 0.04 µg/L.

Atrazine concentrations in the Mohawk River at Cohoes ranged from 0.04 to 0.37 µg/L during the growing season and were less than 0.04 µg/L during the remainder of the year. The sample from this site with the highest atrazine concentration was collected in July 1994, about 1 week after the maximum atrazine concentration observed at Canajoharie Creek. The maximum concentrations of atrazine at this site coincided with the maximum concentration of metolachlor and cyanazine; the maximum concentration of deethylatrazine was observed after a stormflow in August 1994.

Atrazine concentrations in the Lisha Kill were lower than those in the Mohawk River and Canajoharie Creek sites, and the maximum observed concentrations occurred later in the season. Atrazine was detected in samples from the Lisha Kill only from March through September of 1994 and 1995, and the highest concentration observed was not associated with a runoff-producing storm. The maximum concentration of



PESTICIDE	NUMBER OF SAMPLES	CONCENTRATION[1], IN µg/L	
		Maximum	Minimum
DETECTION FREQUENCY	May-Aug / Sept-Apr	May-Aug / Sept-Apr	May-Aug / Sept-Apr
Metolachlor	24 / 10	0.17 / 0.024	0.025 / 0.010
Atrazine	24 / 10	0.37 / 0.021	0.048 / 0.016
Deethylatrazine	24 / 10	0.043 / 0.014	0.009 / 0.007
Diazinon	14 / 9	0.034 / 0.006	0.007 / 0.006
Cyanazine	24 / 10	0.073 / --	0.020 / --
Simazine	24 / 10	0.017 / --	0.009 / --
Alachlor	24 / 10	0.021 / 0.007	0.011 / 0.007
Carbaryl	24 / 10	0.026 / --	0.016 / --
2,6 - Diethylanaline	24 / 10	0.003 / --	0.003 / --
Metribuzin	24 / 10	0.027 / --	0.027 / --
Prometon	24 / 10	0.025 / --	0.025 / --
Terbacil	24 / 10	0.01 / --	0.010 / --
EPTC	24 / 10	0.002 / --	0.002 / --
Tebuthiuron	24 / 10	-- / 0.010	-- / 0.010
Atrazine	25 / 11	4.3 / 0.062	0.042 / 0.029
Metolachlor	25 / 11	1.3 / 0.023	0.020 / 0.011
Deethylatrazine	25 / 11	0.22 / 0.053	0.016 / 0.015
Cyanazine	26 / 11	2.1 / 0.006	0.022 / 0.006
Diazinon	19 / 11	0.035 / 0.024	0.008 / 0.016
Metribuzin	26 / 11	0.033 / --	0.027 / --
Simazine	26 / 11	0.018 / --	0.013 / --
EPTC	25 / 11	0.004 / --	0.004 / --
Pendimethalin	26 / 11	0.035 / --	0.035 / --
Alachlor	26 / 11	-- / 0.002	-- / 0.002
Diazinon	13 / 12	0.13 / 0.55	0.042 / 0.030
Metolachlor	22 / 12	0.023 / 0.005	0.008 / 0.004
Atrazine	25 / 12	0.11 / 0.009	0.019 / 0.006
Carbaryl	25 / 12	0.86 / 0.2	0.057 / 0.020
Deethylatrazine	25 / 12	0.007 / --	0.004 / --
Prometon	25 / 12	0.071 / --	0.024 / --
Metribuzin	25 / 12	0.029 / --	0.024 / --
Simazine	25 / 12	0.013 / --	0.011 / --
Terbacil	24 / 12	0.023 / --	0.023 / --
alpha BHC	25 / 12	0.21 / --	0.210 / --
Molinate	25 / 12	0.016 / --	0.016 / --
Chlorpyrifos	25 / 12	0.009 / --	0.009 / --
Alachlor	25 / 12	0.008 / --	0.008 / --
Pendimethalin	25 / 12	0.006 / --	0.006 / --

[1] Dashes (--) indicate no detections during this period.

Figure 4. Detection frequency, maximum and median (of samples with detection) concentrations of pesticides detected at three sites in the Mohawk River subbasin, March - September 1995.

atrazine at Lisha Kill did not coincide with that of metolachlor or deethylatrazine.

The differences in the timing of observed peak concentrations of atrazine in the summer of 1995 among the three Mohawk River subbasin sites (Fig. 6) is due to differences in (1) the time of application, and (2) the response of streamflow to precipitation. The 1995 Canajoharie Creek sample with the maximum atrazine concentration was collected in early June; this, as in 1994, was 7 days before the maximum atrazine concentration observed in the Mohawk River at Cohoes. This 7-day difference in both years is not surprising because a small watershed generally produces storm runoff more readily than a large basin; this, combined with the large proportion of

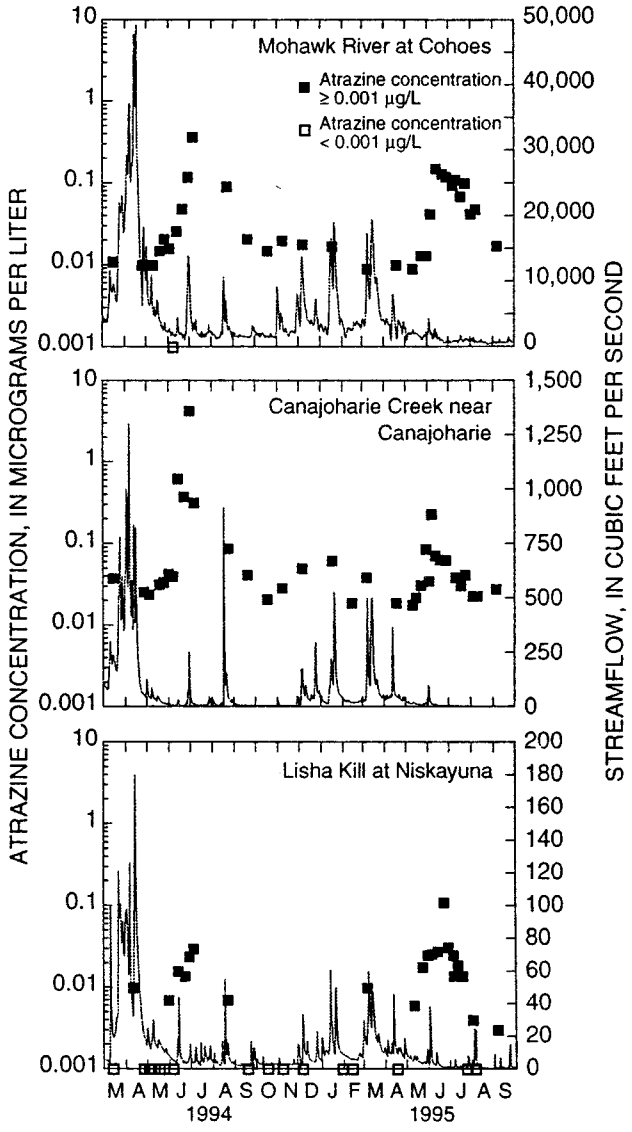


Figure 5. Atrazine concentrations at three sites in the Mohawk River subbasin, March 1994 -September 1995.

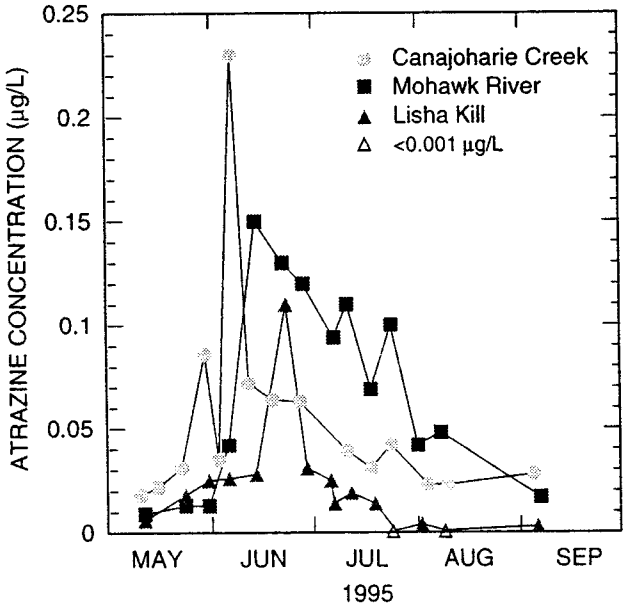


Figure 6. Atrazine concentration, at three sites in the Mohawk River subbasin study, May-September 1995.

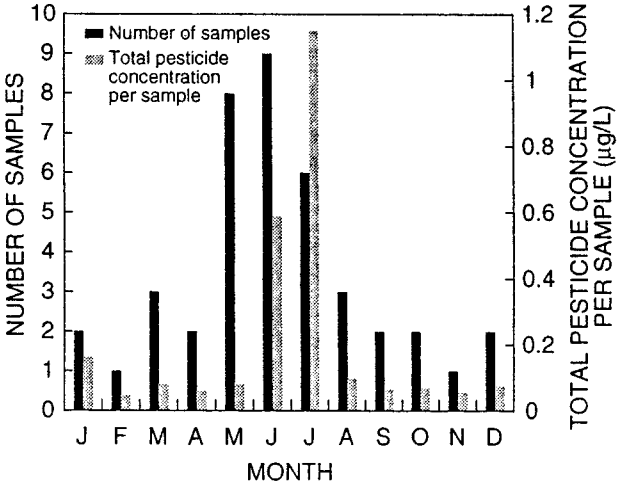


Figure 7. Number of samples and total pesticide concentration per sample at Canajoharie Creek site – March 1994 through March 1996, by month. (Total pesticide concentration per sample is calculated as the sum of all pesticide concentrations detected for a given month, divided by the number of samples collected during that month).

agricultural land in the Canajoharie watershed, resulted in a more rapid increase in atrazine concentration, and higher concentrations in Canajoharie Creek, than in the two other streams. The Mohawk River at Cohoes sustained elevated concentrations longer than Canajoharie Creek, however, because the Mohawk receives runoff from many small watersheds dominated by agricultural land. In addition, several dams along the Mohawk River probably slow the downstream movement of atrazine and other herbicides toward the Cohoes site.

The later peak in atrazine concentration at Lisha Kill than at the other 2 sites is probably the result of a different usage and timing of applications, because the Lisha Kill watershed is predominantly urban/residential and contains much less agricultural land than the other two watersheds.

Canajoharie Creek Study, 1994-96

Results from the 2 years of sampling at the Canajoharie Creek site are summarized in figure 7 and Table 5. Most samples were collected during May, June, and July, the period when pesticides are generally applied to agricultural fields. As expected, the total-pesticide concentration per sample was highest in the June and July samples; the reason that the value for July was higher than that for all other months was that a sample collected on July 1, 1994, contained higher

Table 5. Concentrations of pesticides in water samples collected from Canajoharie Creek near Canajoharie, NY, March 1994 through March 1996 and June 7-11, 1996.

[µg/L, micrograms per liter. Location is shown in fig. 2.]

Pesticide	Detection limit (µg/L)	MCL/HA[1] (µg/L)	March 1994-March 1996				June 7-11, 1996			
			No. of samples	Percentage of samples with detection	Concentration (µg/L)		No. of samples	Percentage of samples with detection	Concentration (µg/L)	
					Median of detections	Maximum			Median of detections	Maximum
Atrazine	0.001	3 / 3	40	100	0.040	4.3	8	100	3.2	20
Metolachlor	0.002	na / 70	40	100	0.019	1.3	8	100	0.535	3.1
Deethylatrazine	0.002	na / na	40	97.5	0.015	0.22	8	100	0.036	0.10
Cyanazine	0.004	na / 1	41	46.3	0.022	2.1	8	100	0.400	0.85
Diazinon	0.002	na / 0.3	34	32.4	0.009	0.035	8	0	–	–
Metribuzin	0.004	na / 100	41	4.9	0.027	0.033	8	0	–	–
Simazine	0.005	4 / 4	41	4.9	0.013	0.018	8	75.0	0.028	0.12
EPTC	0.002	na / na	40	2.5	0.004	0.004	8	0	–	–
Pendimethalin	0.004	na / na	41	2.4	0.035	0.035	8	87.5	0.026	0.061
Alachlor	0.002	2 / na	41	2.4	0.002	0.002	8	100	0.020	0.048
Carbaryl	0.003	na / 700	41	0	–	–	8	12.5	0.008	0.008

[1]MCL - Maximum Contaminant Level; HA - Health Advisory Level

concentrations of atrazine, deethylatrazine, metolachlor, and simazine than any other sample collected during the 1994-96 study. The maximum concentrations of all pesticides except EPTC from March 1994 through March 1996 occurred during periods of storm runoff in June or July.

Samples collected in June 1996 contained the highest concentrations of atrazine, metolachlor, simazine, pendimethalin, alachlor, and carbaryl observed to date (Table 5). Only 2 samples collected during the 2-year period before June 1996 contained a pesticide at a concentration exceeding its MCL or HA (Table 4), and 5 stormflow samples collected over 9.5 hours on June 10, 1996, exceeded the MCL for atrazine. The absence of metribuzin and EPTC in the June 1996 samples was not surprising, in that these pesticides had been detected in only three samples in previous years. The absence of diazinon in the June 1996 samples could reflect (1) an earlier application – 6 of the samples (55 percent of the detections) were collected during April and May, and (or) (2) a change in diazinon use in the watershed (73 percent of the detections were in 1994 samples).

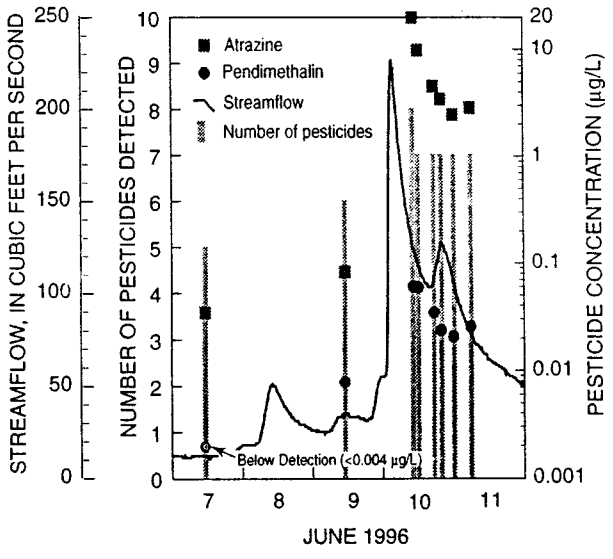


Figure 8. Selected results of pesticide sampling at Canajoharie Creek, June 7-11, 1996.

The estimated atrazine load for 14 hours of the June 10, 1996 stormflow (Fig. 8) was 1.0 kg, 36 times the load of 0.028 kg for a 60-day low-flow period the previous year (June 12 through August 11, 1995). The number of samples collected from March 1994 through March 1996 was insufficient for an accurate estimation of annual pesticide loads, but the 14-hour load on June 10, 1996 probably represented a significant part of the total load for that year.

SUMMARY

Three studies of pesticide concentrations in streams and rivers of the Hudson River Basin were conducted during 1994-96. The first was a basinwide study conducted in 1994, which focused on the occurrence and distribution of pesticides in streams throughout the basin. The second was a study of pesticide concentrations at three sites in the Mohawk River subbasin during 1994-95. The third study focused on pesticide concentrations in stormflow samples from Canajoharie Creek in June 1996 in comparison with data collected at the same site from March 1994 through March 1996.

Analyses of water samples collected at 46 sites on 42 streams and rivers in the basinwide study indicate that pesticide occurrence is related to land use. Herbicides such as atrazine and metolachlor were detected most frequently in samples from watersheds that are predominantly agricultural, and insecticides such as diazinon were detected most frequently in samples from watersheds that are predominantly urban. Pesticide concentrations in most samples were 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.

Results from the 1994-95 Mohawk River subbasin study indicate that pesticide detection and concentrations are related to land use and season. Pesticides commonly used in agricultural settings, such as atrazine, metolachlor, and cyanazine, were found most frequently and at highest concentrations in samples from Canajoharie Creek, which drains a small agricultural watershed. Pesticides that are commonly used in urban or residential settings, such as diazinon and carbaryl, were found most frequently and at highest concentrations in samples from Lisha Kill, which drains a small watershed that is predominately urban. The site at which the largest number of pesticides was detected was the Mohawk River at Cohoes, which represents a large watershed with a mixture of agricultural and urban land. Pesticide concentrations in samples from the Mohawk River at Cohoes were generally lower than those at the two smaller watersheds as a result of dilution from many tributaries. Pesticides at all sites were detected most frequently, and at the highest concentrations, during the growing season (May-August).

Results from the 1994-96 Canajoharie Creek study indicate that total pesticide concentrations per sample were highest during June and July. Stormflow samples collected in June 1996 had the highest concentrations of atrazine and other pesticides commonly used in agricultural settings; the highest atrazine concentration detected in samples from this storm was 20 µg/L. The results of this study suggest that much of the transport of atrazine and other pesticides occurs during storm runoff shortly after application.

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