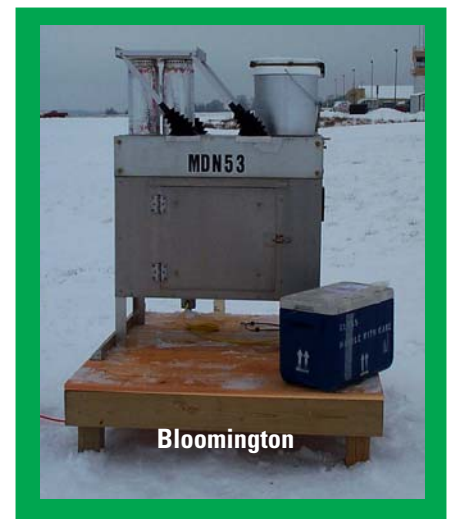


Monitoring Program for Mercury in Precipitation in Indiana: Data Summary for 2001–2005



**U.S. Geological Survey / Indiana Department of Environmental Management
Monitoring Program for Mercury in Precipitation in Indiana
Data Summary for January 2001 through December 2005**

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Monitoring Program Data

The Indiana mercury-monitoring program is part of the National Atmospheric Deposition Program (NADP) Mercury Deposition Network (MDN) in North America. In the NADP-MDN, weekly precipitation samples are collected and analyzed for mercury. The weekly data are finalized and posted on the NADP-MDN website at <http://nadp.sws.uiuc.edu/mdn/>. The data for Indiana presented in this summary are based on the MDN weekly data. A description of the monitoring program for mercury in precipitation in Indiana is available from the U.S. Geological Survey at <http://in.water.usgs.gov/newreports/mercury>.

Monitoring Stations in the Data Summary

Five monitoring stations for mercury in precipitation are operated in Indiana. They are listed by name, NADP-MDN identification number, and location:

- Roush Lake (IN20) near Huntington in Huntington County, northeastern Indiana;
- Clifty Falls (IN21) near Madison in Jefferson County, southeastern Indiana;
- Fort Harrison (IN26) near Indianapolis in Marion County, central Indiana;
- Bloomington (IN28) near Bloomington in Monroe County in southwestern Indiana;
- Indiana Dunes (IN34) near Porter in Porter County in northwestern Indiana.

Four of the monitoring stations were operated January 2001 through December 2005—Roush Lake, Clifty Falls, Bloomington, and Indiana Dunes. The Fort Harrison station was operated April 2003 through December 2005. All five stations are planned to operate during 2006 and through at least 2008.

Contents of the Data Summary

This data summary includes illustrations and tables. Terms used in the data summary are defined in the next section, Terms in the Data Summary.

Five illustrations show the following:

- Annual volume-weighted mercury concentration, annual mercury wet deposition, and annual normalized mercury wet deposition at each station, 2001 through 2005, on a state map (figure 1);
- Annual volume-weighted mercury concentration, annual mercury wet deposition, and annual normalized mercury wet deposition at each station, grouped by year, 2001 through 2005, on bar graphs (figure 2);
- Annual mercury wet deposition and annual precipitation at each station, grouped by station, 2001 through 2005, on bar graphs (figure 3); and
- Distributions of mercury concentrations in weekly precipitation samples (figure 4) and distributions of weekly mercury wet deposition (figure 5) at each station, 2001 through 2005, on box plots.

Three tables summarize information from five monitoring stations in Indiana, 2001 through 2005:

- Number and types of precipitation samples (table 1);
- Total mercury concentrations (table 2); and
- Total mercury wet deposition (table 3).

Terms in the Data Summary

This data summary quantifies precipitation, mercury concentrations, and mercury wet deposition in Indiana. Following are definitions of the terms used in the summary, the units of measure, and methods of determination or calculation.

Precipitation Terms

Weekly precipitation is the amount of rain, snow, and mixed (liquid and frozen) precipitation recorded by the rain gage at the monitoring station. Units are inches because inches are used most frequently in weather reports in the United States. (The NADP-MDN website lists weekly precipitation in millimeters; one inch is equal to 25.4 millimeters; one millimeter is equal to 0.0393701 inch.)

Annual precipitation is the sum of the weekly precipitation amounts for a year (typically 52 weeks).

Precipitation sampling attempted means the weekly installation of a clean sampling bottle and funnel in the automated precipitation collector (<http://in.water.usgs.gov/newreports/mercury>).

Weekly precipitation sample is accumulated in the sampling bottle as the automated collector uncovers the funnel each time precipitation occurs. A sample is defined as 0.01 inch or more of precipitation recorded by the rain gage or accumulated in the sampling bottle during one week.

Dry sample means that less than 0.01 inch of precipitation is recorded by the rain gage or accumulated in the sampling bottle during one week.

Concentration Terms

Mercury concentrations in precipitation samples and mercury wet deposition in this summary are for total mercury. Total mercury includes inorganic mercury and methylmercury.

Mercury concentration is determined by laboratory analysis of the weekly precipitation sample accumulated in the automated collector. Concentration is mercury mass per volume of precipitation. Units are nanograms per liter (equivalent to 0.001 microgram per liter and approximately one part per trillion).

Median mercury concentration is a descriptive statistic for a group of mercury concentrations. When concentrations are ranked from smallest to largest, the median separates the ranked concentrations into two parts—half of the concentrations are greater than the median and half of the concentrations are less than the median. Units are nanograms per liter.

Volume-weighted mercury concentration is a computed value of a group of mercury concentrations weighted by the ratios of the sample volumes of the weekly samples to the total sample volume for the group. The volume-weighted concentration is a better representation of mercury concentrations in a group of precipitation samples than a simple mean (known as an “average”). Large concentrations in small volume samples will bias a simple mean but not a volume-weighted concentration. Units are nanograms per liter.

Deposition Terms

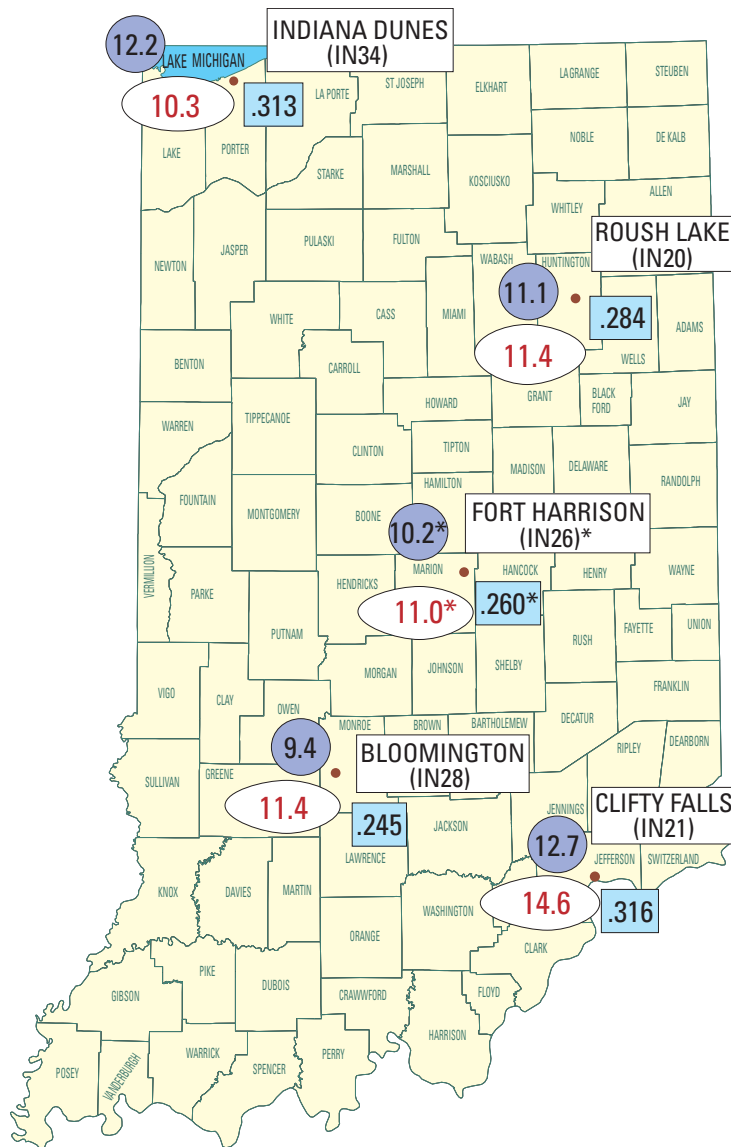
Mercury wet deposition is the rate of mercury mass deposited in precipitation, per unit area, per unit time. Units for the mass per unit area are micrograms per square meter (1 microgram equals 1,000 nanograms).

Weekly mercury wet deposition is the product of the mercury concentration in the weekly precipitation sample and the weekly precipitation amount, divided by the unit area. Units are micrograms per square meter per week.

Estimated weekly mercury wet deposition provides a wet deposition value when a sampler malfunction or other error causes a mercury concentration to not be reported. Mercury wet deposition is estimated with the valid weekly precipitation amount and the seasonal volume-weighted mercury concentration. Units are micrograms per square meter per week.

Annual mercury wet deposition is the sum of the weekly mercury wet deposition for a year (typically 52 weeks). Units are micrograms per square meter per year.

Annual normalized mercury wet deposition is the annual mercury wet deposition divided by the annual precipitation. Differences in annual wet deposition among monitoring stations that are caused by differences in annual precipitation are removed when comparisons are made with normalized wet deposition. Units are micrograms per square meter per year per inch of precipitation.



EXPLANATION

- Mercury monitoring station
- INDIANA DUNES (IN34)** Monitoring station name and Mercury Deposition Network identification number
- 10.3** Annual average mercury wet deposition in micrograms per square meter per year (1 microgram = 1,000 nanograms)
- 12.2** Annual average volume-weighted mercury concentration in nanograms per liter
- .313** Annual average normalized mercury wet deposition in micrograms per square meter per inch of precipitation per year

* Fort Harrison data are from April 2003 -- December 2005

Figure 1. Annual mercury concentrations in precipitation and annual mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2005.

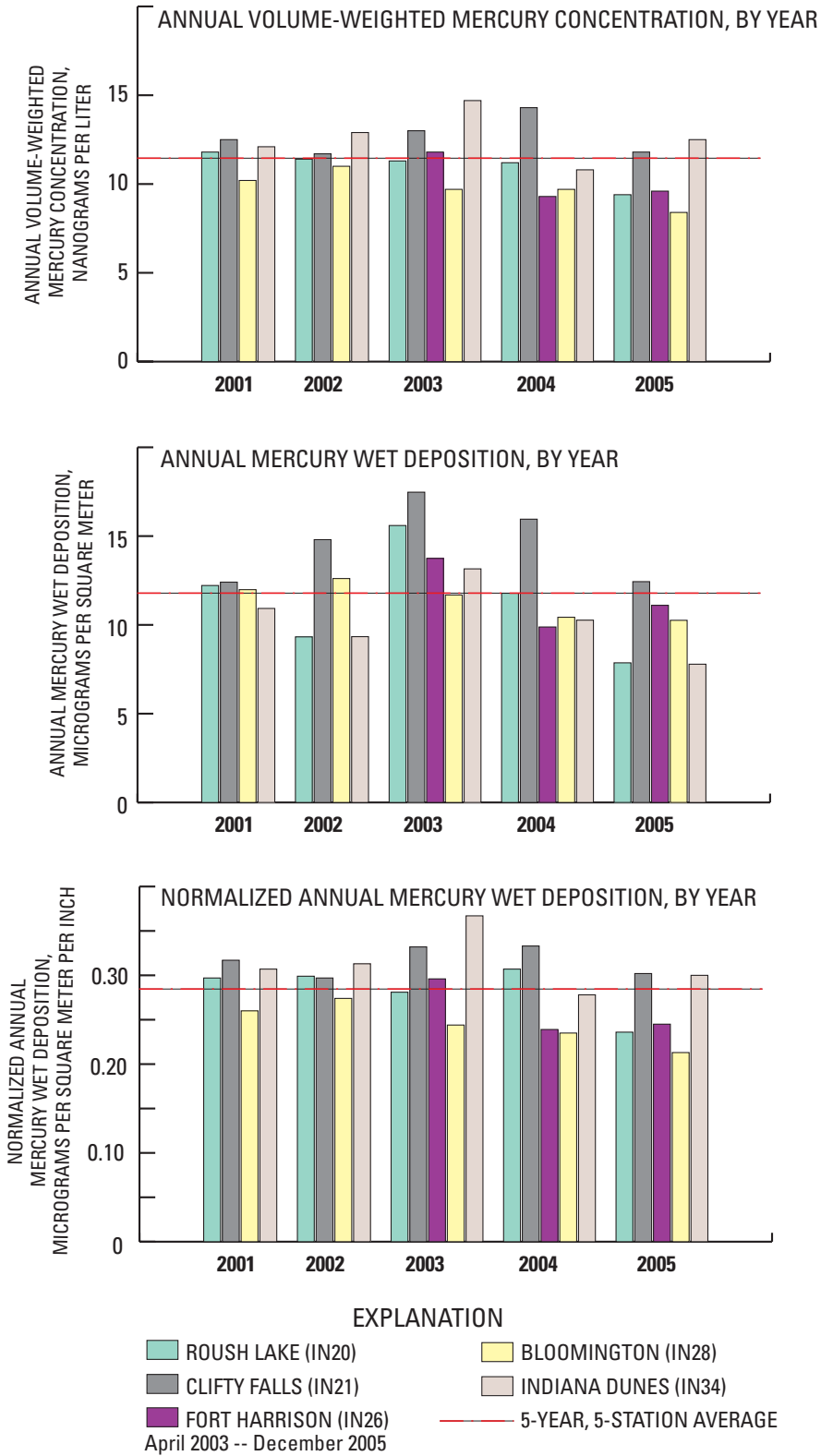


Figure 2. Annual volume-weighted mercury concentrations in precipitation, annual mercury wet deposition, and annual normalized mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2005.

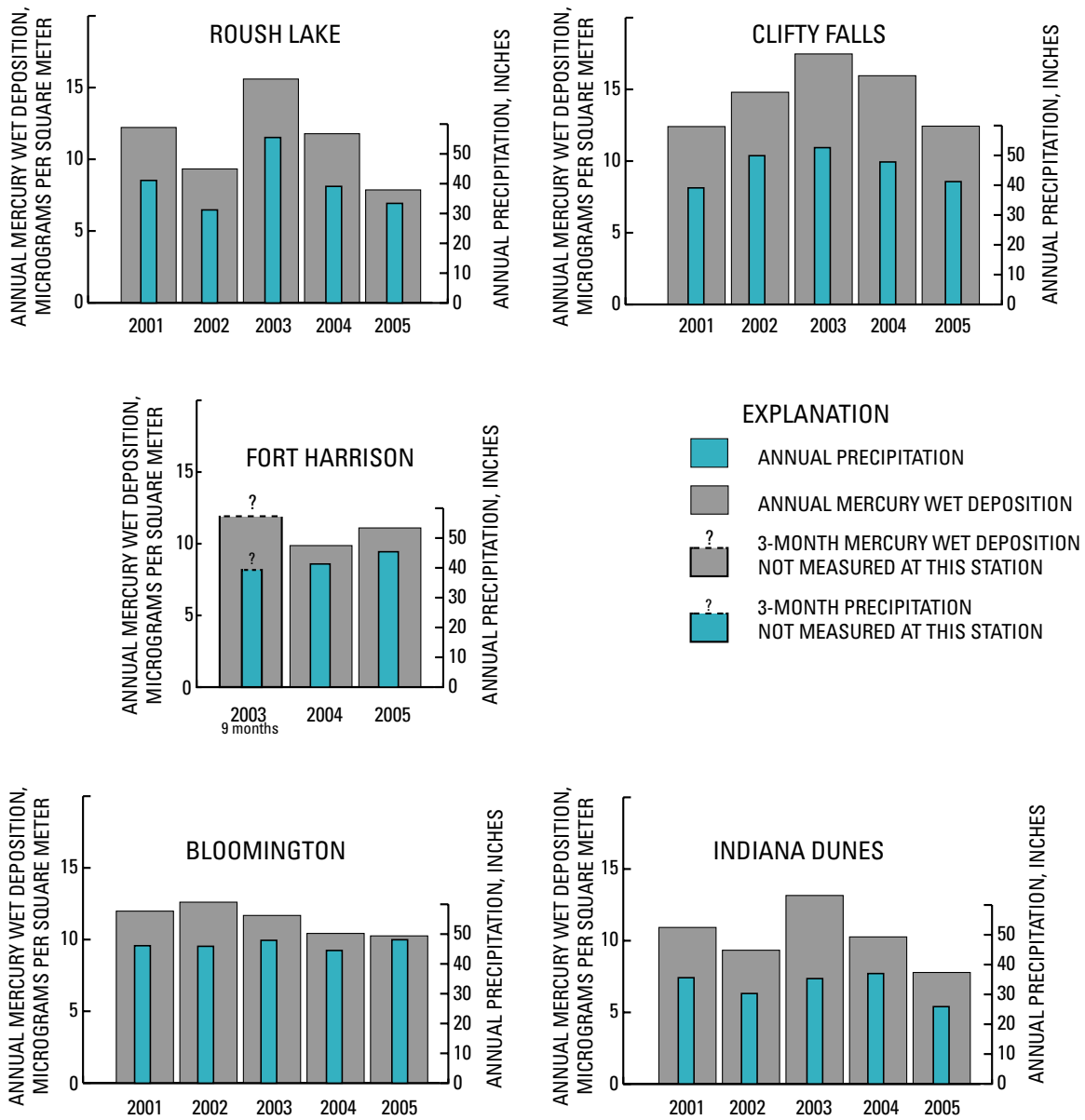


Figure 3. Annual mercury wet deposition and annual precipitation at five monitoring stations in Indiana, January 2001 through December 2005.

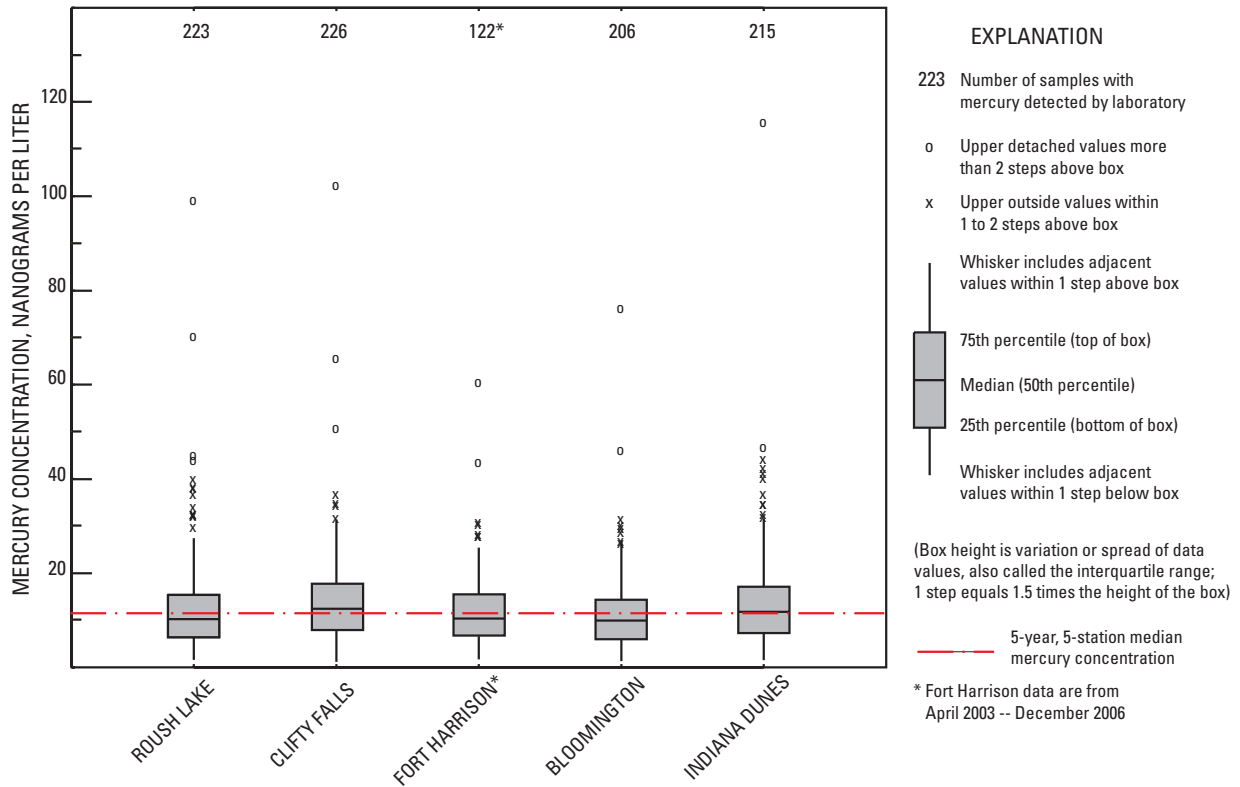


Figure 4. Standard boxplots showing the distribution of mercury concentrations in weekly precipitation samples from five monitoring stations in Indiana, January 2001 through December 2005.

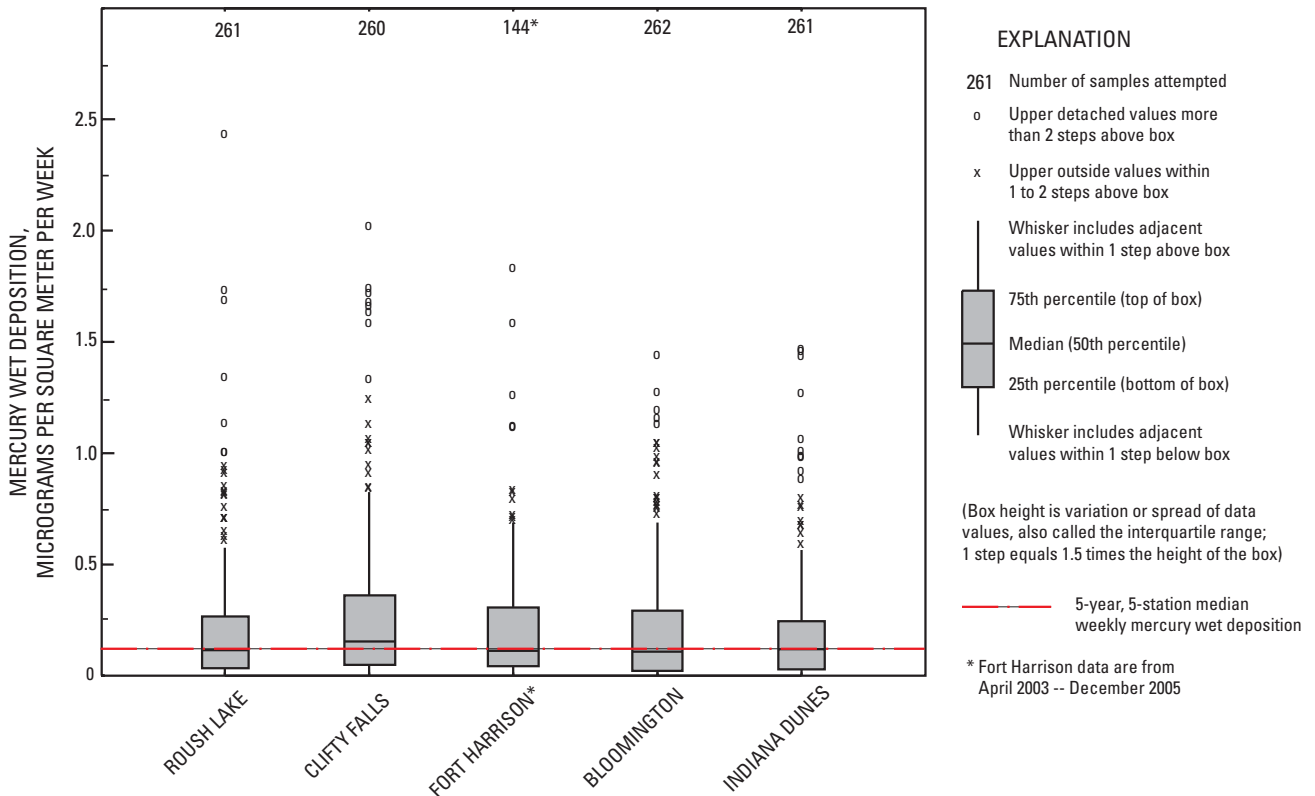


Figure 5. Standard boxplots showing the distribution of weekly mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2005.

Table 1. Number and types of weekly precipitation samples from mercury monitoring at five stations in Indiana, January 2001 through December 2005

[first five shaded rows contain totals for each station; last shaded row contains totals for all five stations]

Station name and Mercury Deposition Network identification number	Year	Number of samples attempted	Number of mercury wet-deposition samples ^a	Number of dry samples ^b	Types of wet-deposition samples		
					Number of rain samples	Number of snow samples	Number of mixed samples ^c
Roush Lake (IN20)	2001	52	46	6	38	2	6
	2002	52	48	4	33	5	10
	2003	53	49	4	33	8	8
	2004	52	42	10	28	1	13
	2005	52	48	4	33	5	10
	5 years	261	233	28	165	21	47
Clifty Falls (IN21)	2001 ^d	50	44	6	39	0	5
	2002	52	45	7	39	3	3
	2003	53	51	2	41	4	6
	2004	52	43	9	36	1	6
	2005	53	49	4	38	2	9
	5 years	260	232	28	193	10	29
Fort Harrison (IN26)	2003 ^e	39	35	4	32	0	3
	2004	52	43	9	34	1	8
	2005	53	46	7	34	3	9
	3 years	144	124	20	100	4	20
Bloomington (IN28)	2001	52	44	8	37	3	4
	2002	52	43	9	37	3	3
	2003	53	44	9	33	5	6
	2004	52	42	10	34	1	7
	2005	53	45	8	33	3	9
	5 years	262	218	44	174	15	29
Indiana Dunes (IN34)	2001	52	46	6	38	1	7
	2002	52	43	9	31	6	6
	2003	53	48	5	32	13	3
	2004	52	47	5	35	4	8
	2005	52	44	8	31	6	7
	5 years	261	228	33	167	30	31
Five stations	5 years	1,188	1,035	153	799	80	156

^aIncludes samples with estimated mercury wet deposition.

^bDry sample defined as less than 0.03 inch of precipitation; includes field blank sample.

^cMixed sample contains liquid and frozen precipitation.

^dDoes not include 2 weeks prior to start of monitoring in January 2001.

^eDoes not include 13 weeks prior to start of monitoring in April 2003.

Table 2. Mercury concentrations in weekly precipitation samples at five monitoring stations in Indiana, January 2001 through December 2005

[ng/L, nanogram per liter; first five shaded rows contain median or volume-weighted mercury concentrations or total number of samples for each station; last shaded row contains median or volume-weighted mercury concentrations or total number of samples for all five stations]

Station name and Mercury Deposition Network identification number	Year	Median mercury concentration (ng/L) ^a	Volume-weighted mercury concentration (ng/L) ^a	Number of samples with mercury detected by laboratory	Number of samples with mercury wet deposition estimated	Number of mercury wet-deposition samples
Roush Lake (IN20)	2001	11.4	11.8	44	2	46
	2002	10.1	11.4	42	6	48
	2003	11.0	11.3	47	2	49
	2004	8.9	11.2	42	0	42
	2005	9.7	9.4	48	0	48
	5 years	10.2	11.1	223	10	233
Clifty Falls (IN21)	2001	11.2	12.5	43	1	44
	2002	13.4	11.7	44	1	45
	2003	12.6	13.0	51	0	51
	2004	14.3	14.3	42	1	43
	2005	11.3	11.8	46	3	49
	5 years	12.4	12.7	226	6	232
Fort Harrison (IN26)	2003 ^b	10.9	11.8	34	1	35
	2004	8.6	9.3	43	0	43
	2005	10.0	9.6	45	1	46
	3 years	10.3	10.2	122	2	124
Bloomington (IN28)	2001	10.9	10.2	44	0	44
	2002	9.8	11.0	35	8	43
	2003	10.3	9.7	42	2	44
	2004	9.5	8.9	41	1	42
	2005	9.3	8.4	45	0	45
	5 years	9.9	9.4	207	11	218
Indiana Dunes (IN34)	2001	12.7	12.1	43	3	46
	2002	11.3	12.9	38	5	43
	2003	14.1	14.7	44	4	48
	2004	10.1	10.8	47	0	47
	2005	11.2	12.5	43	1	44
	5 years	11.7	12.2	215	13	228
Five stations	5 years	11.0	11.4	993	42	1,035

^aMedian and volume-weighted mercury concentrations computed for samples with mercury detected by laboratory. 5-year median and volume-weighted mercury concentrations are computed from weekly concentrations, not from single-year median or volume-weighted mercury concentrations in this table.

^bDoes not include 13 weeks prior to start of monitoring in April 2003.

Table 3. Mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2005[$\mu\text{g}/\text{m}^2$, microgram per square meter; $\mu\text{g}/\text{m}^2/\text{inch}$, microgram per square meter per inch]

Station name and Mercury Deposition Network identification number	Year	Annual precipitation (inch)	Annual mercury wet deposition ^a ($\mu\text{g}/\text{m}^2$)	Annual normalized mercury wet deposition ^b ($\mu\text{g}/\text{m}^2/\text{inch}$)	Average weekly mercury wet deposition ^c ($\mu\text{g}/\text{m}^2$)	Average mercury wet deposition per sample ^d ($\mu\text{g}/\text{m}^2$)
Roush Lake (IN20)	2001	41.1	12.2	0.297	0.235	0.266
	2002	31.2	9.33	.299	.179	.194
	2003	55.5	15.6	.281	.294	.318
	2004	39.1	12.0	.307	.231	.286
	2005	33.4	7.86	.236	.151	.164
	Average	40.1	11.4	.284	.218	.246
Clifty Falls (IN21)	2001	39.1	12.4	.317	.248	.282
	2002	49.9	14.8	.297	.285	.329
	2003	52.6	17.5	.332	.330	.343
	2004	47.8	15.9	.333	.306	.370
	2005	41.2	12.4	.302	.235	.254
	Average	46.1	14.6	.316	.281	.315
Fort Harrison (IN26)	2003 ^e	40.2	11.9	.296	.305	.340
	2004	41.3	9.86	.239	.190	.229
	2005	45.4	11.1	.245	.209	.241
	Average	42.3	11.0	.260	.235	.270
Bloomington (IN28)	2001	46.1	12.0	.260	.230	.272
	2002	45.9	12.5	.274	.242	.292
	2003	47.9	11.7	.244	.220	.266
	2004	44.5	10.5	.235	.201	.249
	2005	48.1	10.3	.213	.194	.228
	Average	46.5	11.4	.245	.217	.261
Indiana Dunes (IN34)	2001	35.6	10.9	.307	.210	.238
	2002	29.8	9.34	.313	.180	.217
	2003	35.8	13.2	.367	.248	.274
	2004	37.0	10.3	.278	.198	.219
	2005	25.9	7.79	.300	.150	.177
	Average	32.8	10.3	.313	.197	.225
5 stations (23 values)	Average	41.5	11.8	.286	.229	.263

^a Includes samples with estimated mercury wet deposition.^b Computed as annual mercury wet deposition divided by annual precipitation.^c Computed as annual mercury wet deposition divided by number of samples attempted (table 1).^d Computed as annual mercury wet deposition divided by number of wet-deposition samples (table 1).^e Does not include 13 weeks prior to start of monitoring in April 2003.