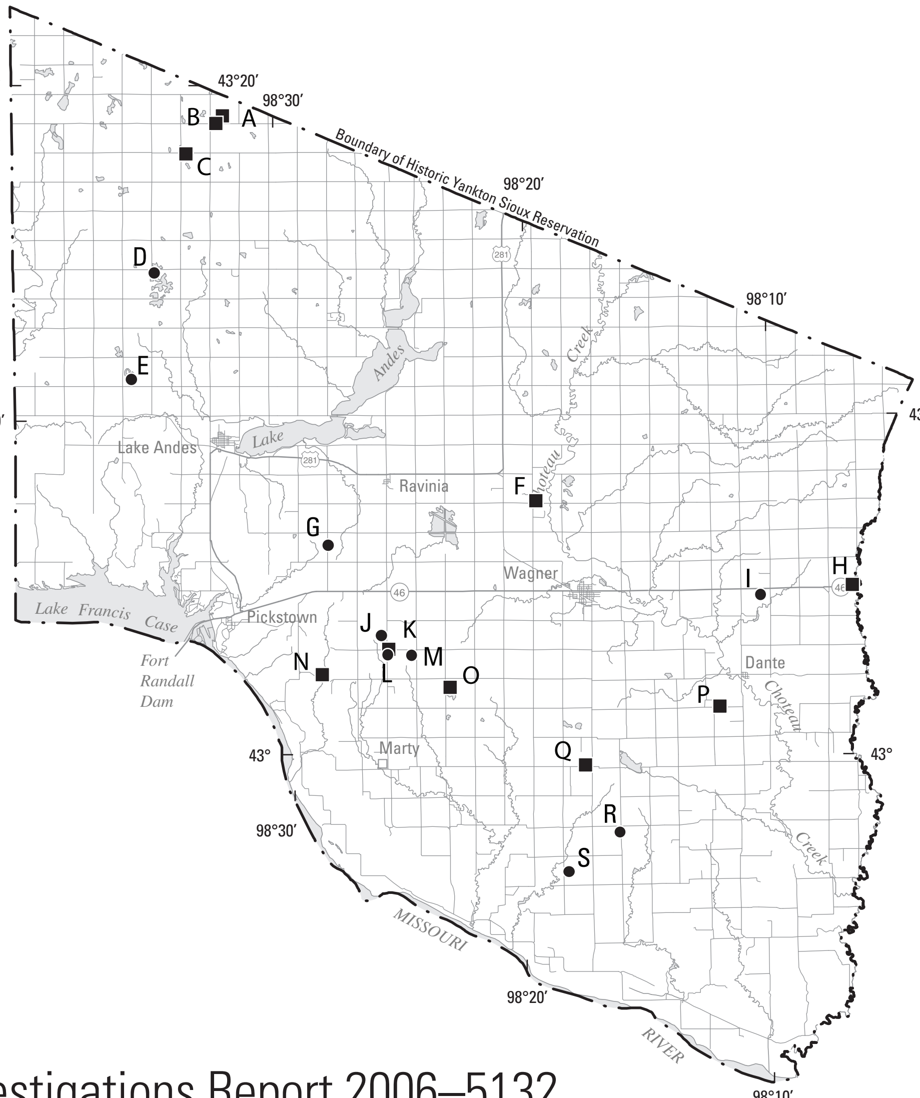
Prepared in cooperation with the Yankton Sioux Tribe

Reconnaissance-Level Assessment of Water and Bottom-Sediment Quality, including Pesticides and Mercury, in Yankton Sioux Tribe Wetlands, Charles Mix County, South Dakota, June–July 2005



Scientific Investigations Report 2006–5132

U.S. Department of the Interior
U.S. Geological Survey

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
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Conversion Factors and Datum

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
pound, avoirdupois (lb)	0.4536	kilogram (kg)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32$$

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm).

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L), micrograms per liter (µg/L), or nanograms per liter (ng/L).

Concentrations of chemical constituents in bottom sediment are given in nanograms per gram (ng/g).

Definition of Acronyms

µm	micron
<	less than
AMPA	Aminomethylphosphonic acid
EPTC	S-ethyl dipropylcarbomothiate
MCL	Maximum Contaminant Level
MCPA	(4-chloro-2-methylphenoxy) acetic acid
NWIS	U.S. Geological Survey National Water Information System
NWQL	U.S. Geological Survey National Water Quality Laboratory
OGRL	U.S. Geological Survey Organic Geochemistry Research Laboratory
PEMC	Palustrine, emergent, seasonally flooded wetland
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
YST	Yankton Sioux Tribe
WDML	Wisconsin District Mercury Laboratory

Reconnaissance-Level Assessment of Water and Bottom-Sediment Quality, including Pesticides and Mercury, in Yankton Sioux Tribe Wetlands, Charles Mix County, South Dakota, June–July 2005

By Bryan D. Schaap and Roy C. Bartholomay

Abstract

During June and July 2005, water and bottom-sediment samples were collected from selected Yankton Sioux Tribe wetlands within the historic Reservation area of eastern Charles Mix County as part of a reconnaissance-level assessment by the U.S. Geological Survey and Yankton Sioux Tribe. The water samples were analyzed for pesticides and mercury species. In addition, the water samples were analyzed for physical properties and chemical constituents that might help further characterize the water quality of the wetlands. The bottom-sediment samples were analyzed for mercury species.

During June 2005, water samples were collected from 19 wetlands and were analyzed for 61 widely used pesticide compounds. Many pesticides were not detected in any of the water samples and many others were detected only at low concentrations in a few of the samples. Thirteen pesticides were detected in water samples from at least one of the wetlands. Atrazine and de-ethyl atrazine were detected at each of the 19 wetlands. The minimum, maximum, and median dissolved atrazine concentrations were 0.056, 0.567, and 0.151 microgram per liter (μg/L), respectively. Four pesticides (alachlor, carbaryl, chlorpyrifos, and dicamba) were detected in only one wetland each. The number of pesticides detected in any of the 19 wetlands ranged from 3 to 8, with a median of 6. In addition to the results for this study, recent previous studies have frequently found atrazine in Lake Andes and the Missouri River, but none of the atrazine concentrations have been greater than 3 μg/L, the U.S. Environmental Protection Agency's Maximum Contaminant Level for atrazine in drinking water.

During June and July 2005, water and bottom-sediment samples were collected from 10 wetlands. Water samples from each of the wetlands were analyzed for major ions, organic carbon, and mercury species, and bottom-sediment samples were analyzed for mercury species. For the whole-water samples, the total mercury concentrations ranged from 1.11 to 29.65 nanograms per liter (ng/L), with a median of 10.56 ng/L. The methylmercury concentrations ranged from 0.45 to 14.03 ng/L, with a median of 2.28 ng/L. For the bottom-sediment samples, the total mercury concentration ranged from 21.3 to 74.6 nanograms per gram (ng/g), with a median of 54.2 ng/g. The methylmercury concentrations ranged from <0.11 to 2.04 ng/g, with a median of 0.78 ng/g. The total mercury concentrations in the water samples were all much less than 2 μg/L (2,000 ng/L), the U.S. Environmental Protection Agency's Maximum Contaminant Level for mercury in drinking water. However, water samples from four of the wetlands had concentrations larger than 0.012 μg/L (12 ng/L), the State of South Dakota's chronic standard for surface waters, including wetlands. Maximum methylmercury concentrations for this study are larger than reported concentrations for wetlands in North Dakota and concentrations reported for the Cheyenne River Indian Reservation in South Dakota.

Introduction

After 1858, the Yankton Sioux Reservation consisted of the eastern part of Charles Mix County (fig. 1). Currently (2006), Yankton Sioux Tribal lands are distributed throughout the historic Yankton Sioux Reservation, which is referred to as the study area. The area is relatively poorly drained, and numerous wetlands provide valuable wildlife habitat. Surface and ground water on the Reservation are used for domestic, stock-water, recreation, and irrigation purposes (Amundson, 2002).

More than 91 percent of the land within the study area is used for row crops, pasture, or hay, and about 6 percent of the area is covered by surface water in the form of wetlands, lakes, and streams (Schaap, 2004). The predominant use of pesticides (including herbicides, insecticides, fungicides, and nematocides) is for row crops (primarily corn and soybeans) that cover about 316 mi^2 or about 46 percent of the Reservation (Schaap, 2004). Estimates of pesticide use in the United States developed by Battaglin and Goolsby (1994) indicated that in 1987, at least 31 different herbicides (table 1) were being used in Charles Mix County with 2,4-D, alachlor, atra-

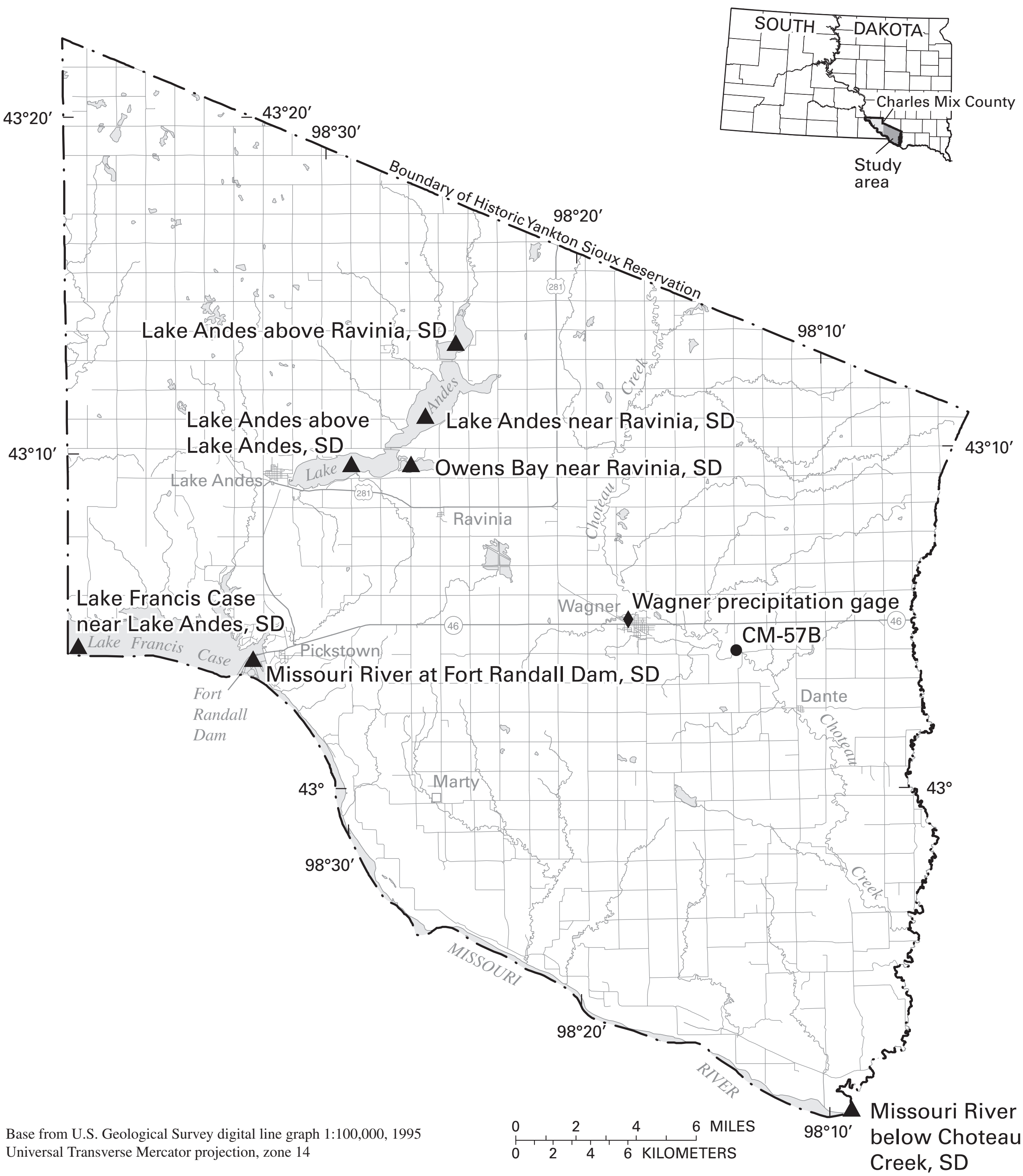

Figure 1. Location of the historic Yankton Sioux Reservation area, sample collection sites from previous studies, the Wagner precipitation site, and the CM–57B observation well.

Table 1. Estimated use of 31 pesticides in Charles Mix County, South Dakota, in 1987.

[Data in columns 3 and 4 from Battaglin and Goolsby (1994). Shaded cells indicate pesticides detected in selected Yankton Sioux Tribe wetlands (fig. 2). YST, Yankton Sioux Tribe; EPTC, s-ethyl dipropylcarbomothiate; MCPA, (4-chloro-2-methylphenoxy) acetic acid; --, not applicable.]

Pesticide	Analyzed for in selected YST wetlands (table 7)	Acres[1] treated	Rank acres treated	Pounds[2] of active ingredient applied	Rank of active ingredient applied (all pesticides)	Rank of active ingredient applied (YST pesticides)	Pounds[3] applied per treated acre	Pounds[4] used per square mile of Charles Mix County
2,4-D	Yes	55,921	1	23,831	5	5	0.426	21.145
2,4-DB	No	357	29	357	23	--	1.000	.317
Acifluorfen	No	1,149	25	287	24	--	.250	.255
Alachlor	Yes	35,042	3	54,636	2	2	1.559	48.479
Atrazine	Yes	21,102	5	19,505	6	6	.924	17.307
Bentazon	No	4,135	14	3,473	14	--	.840	3.082
Bromoxynil	No	13,502	8	4,402	13	--	.326	3.906
Butylate	Yes	2,087	21	8,349	10	10	4.000	7.408
Chloramben	No	763	26	1,756	18	--	2.301	1.558
Chlorsulfuron	No	1,861	22	33	30	--	.018	.029
Cyanazine	Yes	9,393	10	11,178	9	9	1.190	9.918
Dicamba	Yes	51,220	2	13,709	8	8	.268	12.164
Diclofop	No	1,607	23	1,206	20	--	.750	1.070
Difenzoquat	No	203	31	152	25	--	.749	.135
EPTC	Yes	26,273	4	115,516	1	1	4.397	102.498
Ethalfluralin	Yes	2,519	16	2,291	16	13	.909	2.033
Fluazifop	No	230	30	46	28	--	.200	.041
Glyphosate	Yes	4,595	13	2,365	15	12	.515	2.098
Imazethapyr	No	2,297	19	115	26	--	.050	.102
MCPA	No	20,846	6	7,921	12	--	.380	7.028
Metolachlor	Yes	12,915	9	27,052	4	4	2.095	24.003
Metribuzin	Yes	2,482	17	953	21	16	.384	.846
Metsulfuron	No	2,355	18	24	31	--	.010	.021
Pendimethalin	Yes	5,931	12	8,018	11	11	1.352	7.114
Picloram	Yes	2,532	15	1,266	19	15	.500	1.123
Propachlor	Yes	6,338	11	30,571	3	3	4.823	27.126
Sethoxydim	No	459	28	92	27	--	.200	.082
Simazine	Yes	1,333	24	1,999	17	14	1.500	1.774
Thiameturon	No	2,217	20	44	29	--	.020	.039
Triallate	Yes	542	27	542	22	17	1.000	.481
Trifluralin	Yes	20,056	7	15,714	7	7	.784	13.943

[1] Rounded to the nearest acre.

[2] Rounded to the nearest pound.

[3] Calculated for Schaap (2004) from columns 3 and 5.

[4] Rounded to three decimal places.

zine, dicamba, s-ethyl dipropylcarbomothiate (EPTC), (4-chloro-2-methylphenoxy) acetic acid (MCPA), and trifluralin all applied to more than 20,000 acres of cropland (Schaap, 2004). Although recent pesticide-use data are scarce, based on current agricultural practices, it is certain that pesticides are still widely used in the study area.

Pesticides can persist in natural aquatic systems and have long-term effects on biota (Gilliom and others, 2006). Some water-quality pesticide data have been collected by the Yankton Sioux Tribe and the U.S. Geological Survey (USGS) on Lake Andes and the Missouri River (fig. 1), but no data are available for other water bodies within the Reservation. Data collected on Lake Andes indicate that several pesticides, including 2,4-D, atrazine, cyanazine, metolachlor, and simazine, have been detected at concentrations above laboratory reporting levels for multiple samples (Sando and Neitzert, 2003; Schaap, 2004). Some of the pesticides that are applied in the study area (including atrazine, alachlor, and trifluralin) are known endocrine disruptors (Danzo, 1997; Wilson and others, 1996; Rawlings and others, 1998), whereas others (including glyphosate and 2,4-D) have various levels of toxicity to aquatic organisms (U.S. Forest Service, 1997, 1995).

Mercury has long been known to be a health hazard, and recent research has determined that it is commonly found in natural waters, including wetlands. In addition to local sources of mercury, atmospheric mercury emissions from volcanoes and the burning of coal can be transported long distances to make almost all aquatic systems potentially susceptible to mercury contamination. Atmospheric mercury that is introduced to aquatic ecosystems typically occurs in inorganic form, which is not particularly toxic to aquatic organisms. However, under certain conditions that are restricted to aquatic environments, inorganic mercury can be converted to organic mercury (methylmercury; a potent neurotoxin and endocrine disruptor) as a by-product of bacterially mediated sulfate reduction. Methylmercury can then be assimilated by aquatic organisms and biomagnified in the food chain (Krabbenhoft and Rickert, 1995; Sando and others, 2003; Sando, 2004).

Certain aquatic ecosystems (for example, wetlands, newly flooded reservoirs, and seasonal impoundments) are particularly sensitive to mercury inputs due to the presence of favorable conditions for mercury methylation (Ware and others, 1991; Spry and Wiener, 1991; Bodaly and others, 1997; Wiener and others 2002). Conditions that favor mercury methylation include (1) presence of adequate organic carbon; (2) anoxia at the sediment/water interface; (3) presence of sulfate within a specific concentration range; and (4) presence of inorganic mercury in bio-available form. Based on research in North Dakota (Sando and others, 2003; Sando, 2004) in areas that are physiographically similar to the Yankton Sioux Reservation, it is likely that some wetlands on the Reservation may have favorable conditions for mercury methylation.

To address the concerns about the quality of water in Yankton Sioux Tribe wetlands, the U.S. Geological Survey, in cooperation with the Yankton Sioux Tribe, conducted a reconnaissance-level study of water and bottom-sediment quality of selected wetlands. The samples were analyzed for 61 widely used pesticides and for mercury species to determine the occurrence and concentrations of these constituents. Also, information was collected about various physical properties and other water-quality constituents, such as major ions and organic carbon, which might further help to characterize the water quality of the wetlands. The locations of the selected Yankton Sioux Tribe wetlands from which samples were collected are shown in figure 2.

Purpose and Scope

The purpose of this report is to present the results of a reconnaissance-level assessment of water and bottom-sediment quality in Yankton Sioux Tribe wetlands during June–July 2005 in Charles Mix County, South Dakota. Specifically, this report presents (1) a summary of sample collection and analytical methods; (2) concentrations of selected constituents for selected wetlands in the study area; and (3) a synopsis of the atrazine and mercury results. Analytical results for water samples include physical properties and pesticide concentrations from 19 wetlands; mercury, major ions, and organic carbon concentrations from 10 wetlands; and concentrations of chlorophyll *a* and pheophytin *a* (Supplemental Information section A) and nitrogen and phosphorus (Supplemental Information section B) from 2 wetlands. Analytical results for bottom-sediment samples include mercury concentrations and characteristics from 10 wetlands. The quality of water and bottom sediment in all Yankton Sioux Tribe wetlands cannot be thoroughly characterized with such a limited sampling program. The results may be used to assess the effects of land-management practices on the aquatic resources and identify possible water-quality problems that could be the focus of more comprehensive investigations in the future.

Description of the Study Area

The study area is about 686 mi^2, which includes the westernmost extent of continental glaciation and the eastern edge of the Great Plains (Bryce and others, 1998). This area includes parts of the Southern Missouri Coteau, Southern Missouri Coteau Slope, and Southern River Breaks ecoregions (fig. 2), which are distinguished on the basis of topography, soil types, and plant types. The Southern Missouri Coteau ecoregion is characterized by gradual changes in elevation and small areas of high density wetlands. The Southern Missouri Coteau Slope ecoregion is a transitional area between the Southern Missouri Coteau ecoregion to the north and the Southern River Breaks ecoregion to the south. The Southern River Breaks ecoregion, located along the Missouri River, is characterized by deciduous forest in the draws and northern aspects (Bryce and others, 1998).

The quality of water and sediment in wetlands may be affected by the source of the water and the sediment and by their transport to the wetlands. The water in the individual

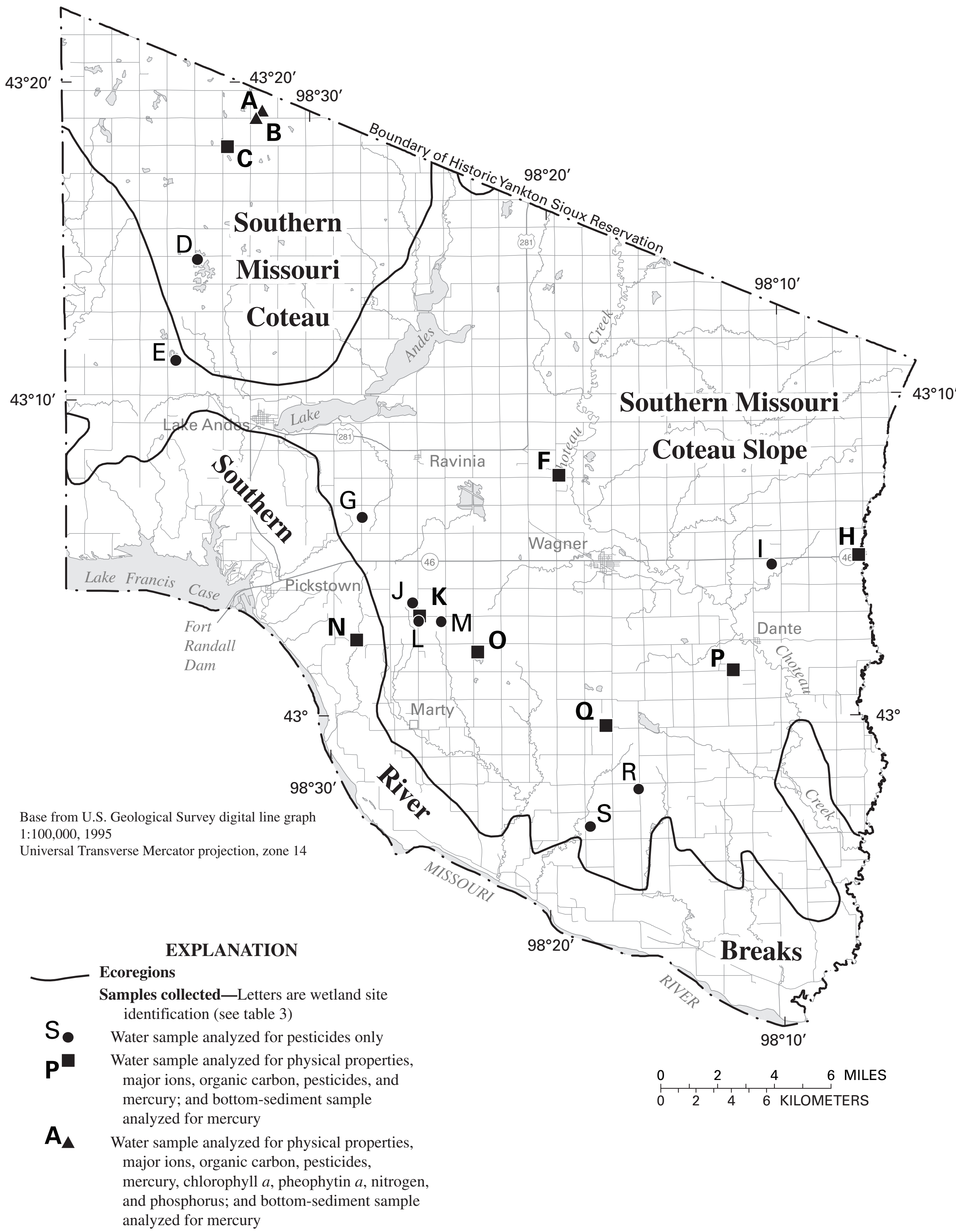

Figure 2. Ecoregions and locations of selected Yankton Sioux Tribe wetlands at which water and bottom-sediment samples were collected during June–July 2005.

wetlands may be from a combination of precipitation, surface-water runoff, and ground-water recharge, and the relative contributions of each source may vary with time and conditions. The nature of the sediment in the individual wetlands may be most affected by local geology.

The contributions from precipitation and surface-water runoff to the wetlands are affected by the amount and the time of precipitation. The samples described in this report were collected within a few days or weeks after large rainfall events. The mean annual precipitation at Wagner (fig. 1) during 1971–2000 was 25.64 in. (South Dakota State University, 2005a). Annual precipitation during the 3 years prior to sampling (2002–2004), had been 5.55, 5.65, and 0.53 in. less than the 30-year average, respectively (South Dakota State University, 2005b), and many of the wetlands that were sampled had little or no water in them during the end of 2004. During the first few months of 2005, precipitation was close to the average (fig. 3), but above-average precipitation during June and July provided enough water so that water-quality samples could be collected from several wetlands. On 8 of the 11 days during June 3–13, measurable precipitation was recorded at Wagner for a total of 4.78 in. during this period. After water-quality samples were collected from 19 wetlands during June 13–17, 2005, additional precipitation recorded at Wagner within the next few weeks included 3.30 in. on June 21 and 0.43 in. on July 6 (National Oceanic and Atmospheric Administration, 2005). This precipitation was sufficient to allow water-quality samples to be collected from 10 wetlands during July 11–13, 2005.

Ground-water recharge to the wetlands is affected by the hydraulic connection between the wetlands and the local ground-water system and relative water levels. Characterizing the hydraulic connection between the individual wetlands and the local ground-water system is beyond the scope of this report, but some information about local hydrogeology and historical ground-water levels may help to explain why a wide range of conditions might be represented by the sampled wetlands.

The general geology of the study area consists of glacial drift of varying thickness on top of a bedrock shale (Kume, 1977). The Quaternary-age deposits of alluvium, outwash, loess, and till overlie Cretaceous-age deposits of Pierre Shale and Niobrara Marl (Hedges, 1975). The till and the bedrock shale may have very low hydraulic conductivity, and wetlands in these areas may be essentially isolated from the ground-water system. Other wetlands may be hydraulically connected to surficial aquifers such as the Choteau, Corsica, Geddes, Tower, Greenwood, or Delmont aquifers, which are composed of Quaternary-age sand and gravel deposits (Kume, 1977). For those wetlands with a hydraulic connection to the local ground-water system, movement of water between the wetlands and the surficial aquifers would be affected by the water levels in the wetlands and in the surficial aquifers.

No water-level records are available for the Yankton Sioux Tribe wetlands, but periodic measurements of ground-water levels at observation well CM-57B (fig. 1) may provide a range for water-depth fluctuations that may occur in some of the wetlands. Well CM-57B is part of a statewide monitoring network supported by the State of South Dakota and is completed in the Delmont aquifer in the eastern part of the study area. From November 7, 1957, to October 5, 2005, ground-water levels at CM-57B were measured more than 400 times

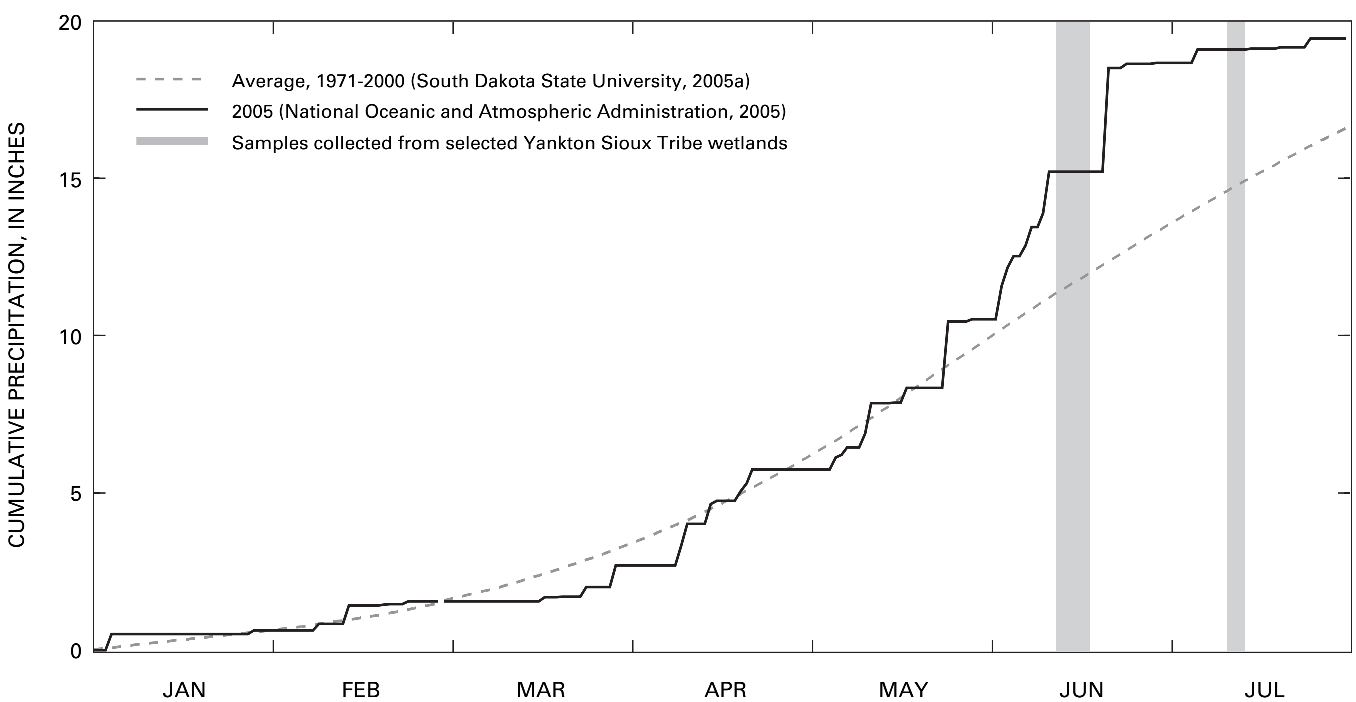

Figure 3. Cumulative average and 2005 daily precipitation at Wagner, Charles Mix County, South Dakota, January–July.

(Randy Anderson, South Dakota Department of Environment and Natural Resources, written commun., 2005). Water levels varied more than 9 ft during the period of record, from 0.8 ft above land surface on April 22, 1986, to 8.6 ft below land surface on October 24, 1991 (fig. 4). The number of measurements per year ranged from 1 in 1957 and 1959 to 18 in 1971. Based on a simple averaging of the individual water-level measurements per year, the average annual water level varied more than 6 feet during the period of record, from 1.6 ft below land surface in 1986 to 7.7 ft below land surface during 1991.

Previous Investigations

Although little information is available about the water and sediment quality in wetlands of the Yankton Sioux Tribe, the findings of five previous investigations were useful in developing the study described in this report. Two of these previous investigations examined surface-water quality in the study area, and the other three examined the distribution of mercury in wetlands in North Dakota and South Dakota.

The water and sediment quality of the Lake Andes and Choteau Creek Basins were studied during 1983–2002 (Sando and Neitzert, 2003; U.S. Geological Survey, 2002, 2003). During the study, the distributions of many constituents were examined, but the pesticide information was based on water-quality samples collected during 1990–2002 from three locations in Lake Andes and one location in Owens Bay, a large marshy area that drains into Lake Andes (fig. 1). The samples analyzed for pesticides were collected in April, May, or June. During 1990–2000, samples were analyzed for dissolved pesticides (Sando and Neitzert, 2003). During 2001–2002, samples were analyzed for total pesticides (dissolved and suspended sediment) (U.S. Geological Survey, 2002, 2003). The atrazine concentrations from this previous study are compared to the atrazine concentrations in the wetlands described in this report in the “Synopsis of Atrazine and Mercury Results” section later in this report.

As part of an on-going data collection effort begun in 2002, water-quality samples have been collected throughout the year, about once every 2 months, from Lake Francis Case, the Missouri River at Fort Randall Dam, and the Missouri River below Choteau Creek (fig. 1) and analyzed for many constituents. During 2002–2005, samples collected in April, May, or June at these sites also were analyzed for selected pesticides (U.S. Geological Survey, 2003–2006). Analytical results from the Missouri River samples for 7 of the 13 pesticides detected in the Yankton Sioux Tribe wetlands are presented in table 2. The atrazine concentrations from this previous study are compared to the atrazine concentrations in the wetlands in the “Synopsis of Atrazine and Mercury Results” section later in this report.

The distribution of mercury in the surface water of the Red River of the North Basin in North Dakota, Minnesota, and Manitoba was studied by Sando and others (2003) during March–August, 2001. The highest whole-water total mercury concentration was found in the single wetland from which samples were collected. For both the winter and summer sampling periods, the whole-water total mercury and whole-water methylmercury concentrations found in the wetland were higher than those detected in Devils Lake or Lake Ashtabula.

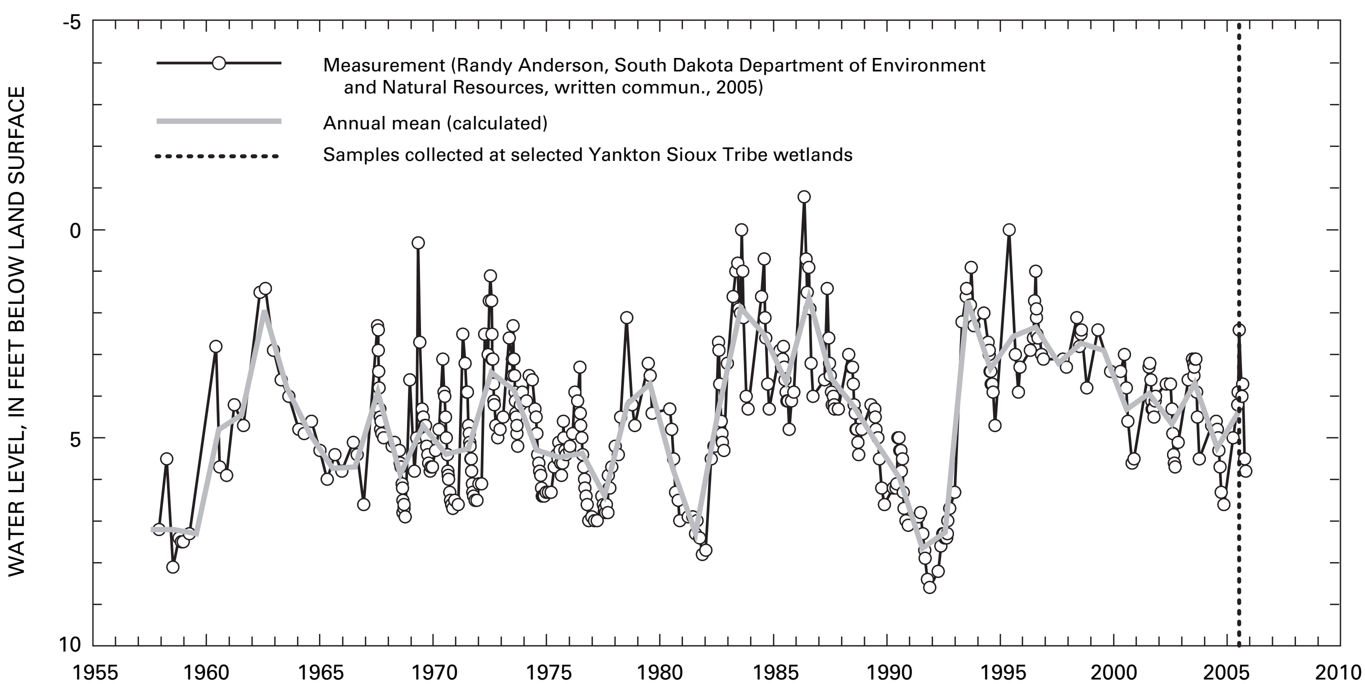

Figure 4. Ground-water levels at Charles Mix County observation well CM–57B, 1957–2005.

The distribution of mercury in the atmosphere, water, and bottom sediments from wetlands in the Lostwood National Wildlife Refuge along the Missouri River in North Dakota was studied by Sando (2004) during 2003–2004. The Lostwood National Wildlife Refuge is located in an area where several coal-combustion plants are in operation. This study found a wide range of mercury concentrations in the wetlands with the largest whole-water methylmercury concentration of 9.56 ng/L. Analyses indicate that the methylmercury concentrations appeared to be related to various physical properties, such as pH, organic carbon, and sulfate (Sando, 2004).

A study performed by the U.S. Environmental Protection Agency (USEPA) in cooperation with the Cheyenne River Sioux Tribe examined mercury concentrations in fish, water, and sediment from several sites on the Cheyenne River Indian Reservation during 2003-2004. Concentrations of methylmercury for water samples at Lee Dam (an earthen dam on Virgin Creek) ranged from 0.4 to 2.9 ng/L, and total mercury ranged from 0.5 to 100 ng/L (U.S. Environmental Protection Agency, 2005).

Methods of Investigation

The study was designed to provide a reconnaissance-level assessment of water and bottom-sediment quality of wetlands within the historic Yankton Sioux Reservation area. Water-quality samples were collected for pesticide analyses from 19 wetlands during June 2005. Water-quality samples for other constituents and sediment-quality samples were collected from 10 of the 19 wetlands during June–July 2005. Site selection, sample collection, analytical methods, reporting levels, and quality assurance and quality control are described in this section.

Sampled Wetlands

Samples were collected from 19 Yankton Sioux Tribe wetlands. Every effort was made to sample a broad range of wetlands in terms of geography, size, and type (as indicated by the U.S. Fish and Wildlife Service National Wetlands Inventory; table 3). Unfortunately, few wetlands were available for sampling because of below-average precipitation in preceding years. Nevertheless, the wetlands from which samples were collected were fairly well distributed throughout the study area (fig. 2). The area of the sampled wetlands ranged from a few acres (several sites) to a few hundred acres (site D; Goose Lake), but in most cases the area covered by water at the time of sampling was considerably less than the area covered by wetlands vegetation. The small number of wetlands available for sampling also affected the types of wetlands that could be sampled. Eighteen of the sampled wetlands had a wetlands inventory code (U.S Fish and Wildlife Service, 2004), and 10 of these were of the type PEMC (Palustrine, Emergent, Seasonally Flooded; for more information see Supplemental Information section C).

Sample Collection

In general, sampling procedures followed guidelines described by Wilde and others (2004) using two-person ultra-clean procedures, but these procedures were adapted to the conditions encountered at the different sites. For each set of samples, this process involved some combination of collecting water in the bottles, directly or after filtering, or collecting several liters of water in a large container and later transferring it to the appropriate bottles in the laboratory.

For determination of dissolved constituents, filtering was performed using precleaned 0.45-micron (μm) capsule filters for inorganic constituents or precleaned baked glass-fiber 142-mm filters for organic constituents. Preservatives of nitric acid, hydrochloric acid, and sulfuric acid were added as needed to the samples with regards to analytical methodology requirements. All samples were chilled according to sample specifications and then sent to the appropriate laboratory so that they arrived the day after they had been collected.

For analysis of mercury species, two-person ultra-clean sampling procedures (U.S. Environmental Protection Agency, 1996; Olson and DeWild, 1999; Wilde and others, 2004) were used to collect all water and bottom-sediment samples. Whole-water samples were collected by hand grab from about mid-depth in the water column near the centroid of the wetland. Samples were chilled with ice and sent by overnight carrier to the USGS Wisconsin District Mercury Laboratory (WDML) in Middleton, Wisconsin, where they were passed through an ultra-clean, 0.7-nominal-pore-size, quartz-fiber filter. The filtered sample is operationally referred to as “dissolved” in this report. To determine particulate concentrations of mercury constituents, known volumes of sample water were passed through the ultra-clean quartz-fiber filters. The remaining particulate material and filter were digested, and the resulting solution was analyzed. Mass/volume concentrations of particulate mercury constituents then were determined on the basis of the original known volume of sample water that was filtered (Sando and others, 2003). The whole-water total mercury concentration was obtained by summing the concentrations of the dissolved and particulate fractions of the sample. The bottom-sediment samples were collected using rigorously cleaned plastic scoops from depositional zones where the surficial sediments consisted primarily of fine-grained material. Sampling equipment was rinsed three times with wetland water prior to sample collection. For each wetland, subsamples of the top 1 to 2 in. of the sediment were collected at 5 to 10 locations near where the water samples were collected. The subsamples were composited into double polyethylene bags, homogenized, and a single sample was collected of the homogenized material and placed in a vial contained inside the double polyethylene bags. The bottom-sediment samples were chilled with dry ice and shipped to the WMDL for analyses.

Table 2. Selected pesticides in water from Lake Francis Case and the Missouri River, 2002–2005.

[Location of stations shown in figure 1. All concentrations of dissolved pesticides in micrograms per liter. <, less than; E, estimated; --, no data. Data from U.S. Geological Survey (2003–2006). Shading represents estimated values or values greater than the reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Date	2,4-D (39730)	Acetochlor (49260)	Alachlor (46342)	AMPA (62649)	Atrazine (39632)	Carbaryl (82680)	Chlorpy-rifos (38933)	De-ethyl atrazine (04040)	Dicamba (82052)	Dichlor-prop (82183)	Glyphosate (62722)	Metolachlor (39415)	Picloram (39720)
430419098401600 Lake Francis Case near Lake Andes, SD													
04-22-2002	--	<0.006	<0.004	--	0.023	<0.041	<0.005	E0.006	--	--	--	E0.010	--
05-20-2002	--	E.005	<.004	--	.025	<.041	<.005	E.004	--	--	--	E.005	--
04-21-2003	--	<.006	<.004	--	.017	<.041	<.005	E.003	--	--	--	<.013	--
06-10-2003	--	.009	<.004	--	.020	<.041	<.005	E.005	--	--	--	E.006	--
04-19-2004	--	.006	<.005	--	.018	<.041	<.005	E.006	--	--	--	E.007	--
05-24-2004	--	.009	<.005	--	.022	<.041	<.005	E.006	--	--	--	E.006	--
04-18-2005	--	<.006	<.005	--	.013	<.041	<.005	<.006	--	--	--	<.006	--
05-10-2005	--	E.003	<.005	--	.014	<.041	<.005	E.003	--	--	--	E.002	--
06453000 Missouri River at Fort Randall Dam, SD													
04-23-2002	--	<0.006	<0.004	--	0.021	<0.041	<0.005	E0.005	--	--	--	E0.009	--
05-21-2002	--	.009	<.004	--	.027	<.041	<.005	E.005	--	--	--	E.006	--
04-22-2003	--	<.006	<.004	--	.020	<.041	<.005	E.006	--	--	--	E.004	--
06-09-2003	--	.012	<.004	--	.025	<.041	<.005	E.005	--	--	--	E.007	--
04-20-2004	--	.006	<.005	--	.022	<.041	<.005	E.006	--	--	--	E.008	--
05-25-2004	--	.009	<.005	--	.022	<.041	<.005	<.006	--	--	--	E.006	--
04-19-2005	--	<.006	<.005	--	.012	<.041	<.005	E.003	--	--	--	<.006	--
05-09-2005	--	E.003	<.005	--	.017	<.041	<.005	E.004	--	--	--	E.002	--
06453305 Missouri River below Choteau Creek, near Verdel, NE													
04-24-2002	--	<0.006	<0.004	--	0.023	<0.041	<0.005	<0.006	--	--	--	E0.009	--
05-22-2002	--	.014	<.004	--	.040	<.041	<.005	E.007	--	--	--	E.006	--
04-23-2003	--	<.006	<.004	--	.020	<.041	<.005	E.006	--	--	--	E.004	--
06-11-2003	--	.011	<.004	--	.021	<.041	<.005	E.004	--	--	--	E.007	--
04-21-2004	--	.007	<.005	--	.021	<.041	<.005	E.006	--	--	--	E.008	--
05-26-2004	--	.009	<.005	--	.024	<.041	<.005	E.006	--	--	--	E.006	--
04-20-2005	--	<.006	<.005	--	.014	<.041	<.005	<.006	--	--	--	<.006	--
05-11-2005	--	.013	<.005	--	.018	<.041	<.005	<.006	--	--	--	E.002	--

Table 3. Selected Yankton Sioux Tribe wetland sampling sites and constituents analyzed for in 2005.

[W, water sample; B, bottom-sediment sample; --, no samples collected]

Site (fig. 2)	Station number	Wetlands inventory code (table C1)	Collection date and matrix							
			Physical properties (table 4)		Major ions (table 5)	Organic carbon (table 6)	Pesticides (tables 7, 8)	Mercury (table 9)	Chlorophyll *a*, pheophytin *a* (table A1)	Nitrogen, phos-phorus (table B1)
A	431907098321000	PEMC	6/14 (W)	--	6/14 (W)	6/14 (W)	6/14 (W)	6/14 (W, B)	6/14 (W)	6/14 (W)
B	431853098322600	PEMC	6/14 (W)	--	6/14 (W)	6/14 (W)	6/14 (W)	6/14 (W, B)	6/14 (W)	6/14 (W)
C	431759098334000	PABF	6/16 (W)	7/13 (W)	7/13 (W)	7/13 (W)	6/16 (W)	7/13 (W, B)	--	--
D	431426098345800	None	6/16 (W)	--	--	--	6/16 (W)	--	--	--
E	431116098355600	PEMC	6/16 (W)	--	--	--	6/16 (W)	--	--	--
F	430735098193000	PEMC	6/13 (W)	[1]7/11 (W)	[1]7/11 (W)	[1]7/11 (W)	6/13 (W)	[1]7/11 (W, B)	--	--
G	430618098275800	PEMC	6/16 (W)	--	--	--	[2]6/16 (W)	--	--	--
H	430500098064000	PEMFd	6/13 (W)	7/12 (W)	7/12 (W)	7/12 (W)	6/13 (W)	7/12 (W, B)	--	--
I	430443098102200	PEMCd	6/13 (W)	--	--	--	6/13 (W)	--	--	--
J	430335098254800	PEM/ABF	[1]6/16 (W)	--	--	--	[1]6/16 (W)	--	--	--
K	430311098253000	PEMC	6/16 (W)	7/12 (W)	7/12 (W)	7/12 (W)	6/16 (W)	7/12 (W, B)	--	--
L	430300098253300	PEMC	6/16 (W)	--	--	--	6/16 (W)	--	--	--
M	430300098243400	PEMC	6/15 (W)	--	--	--	6/15 (W)	--	--	--
N	430226098281400	PFOC	[1]6/16 (W)	7/12 (W)	7/12 (W)	7/12 (W)	[1]6/16 (W)	7/12 (W, B)	--	--
O	430202098230300	PEMC	6/15 (W)	7/13 (W)	7/13 (W)	7/13 (W)	6/15 (W)	7/13 (W, B)	--	--
P	430125098120600	PEM/ABF	6/13 (W)	7/12 (W)	7/12 (W)	7/12 (W)	6/13 (W)	7/12 (W, B)	--	--
Q	425941098173400	PEMC	6/15 (W)	7/11 (W)	[2]7/11 (W)	[2]7/11 (W)	6/15 (W)	[2]7/11 (W, B)	--	--
R	425740098161100	PEM/ABF	6/15 (W)	--	--	--	6/15 (W)	--	--	--
S	425631098181600	PEM/ABF	6/15 (W)	--	--	--	6/15 (W)	--	--	--

[1] Replicate sample collected.

[2] Field blank sample collected (water only).

Analytical Methods

Standard methods were used to analyze samples for physical properties, major ions, organic carbon, chlorophyll *a*, pheophytin *a*, and nitrogen and phosphorus species (table 3) at the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado (information on specific analytical methods can be accessed at *http://nwql.usgs.gov/Public/ref_list.html*). Samples for pesticides were analyzed at NWQL and the USGS Organic Geochemistry Research Laboratory (OGRL) in Lawrence, Kansas. Analyses for most of the 61 pesticides were performed at NWQL using methods described in Wershaw and others (1987) and Zaugg and others (1995). Analyses for the pesticides aminomethylphosphonic acid (AMPA), glufosinate, and glyphosate were performed at OGRL using methods described in Lee and others (2001). Analyses for the mercury samples were performed at WDML using methods and procedures described in Olson and DeWild (1999) and DeWild and others (2002).

Reporting Levels

The presence of some constituents, even at very low concentrations, is of interest because of the potential health effects of these constituents. Childress and others (1999) provides details about the approach used by the USGS regarding detection levels and reporting levels.

The method detection limit is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the concentration is greater than zero. The laboratory reporting level is the concentration at which the false negative error rate is minimized to be no more than 1 percent of the reported results. The laboratory reporting level generally is equal to twice the yearly determined long-term method detection level, which is a detection level derived by determining the standard deviation of a minimum of 24 method detection limit spike-sample measurements over an extended time. The long-term method detection level controls false positive error and is the concentration at which the false positive risk is minimized to be no more than 1 percent of the reported values (Childress and others, 1999). These reporting levels may be described as preliminary for a developmental method if the levels have been based on a small number of analytical results. Also, these levels may vary from sample to sample for the same constituent and the same method if matrix effects or other factors arise that interfere with the analysis. Concentrations measured between the method detection limit and the laboratory reporting level are described as estimated values. For most of the constituents in this report, reported concentrations generally are greater than laboratory reporting levels. Reported concentrations for mercury are greater than the method detection limit as described in Dewild and others (2002).

The minimum reporting level is defined by the NWQL as the smallest measured concentration of a substance that can be reliably measured by using a given analytical method (Timme, 1995) and is used to indicate detection for chlorophyll *a* and pheophytin *a* in this report. The minimum reporting level does not have the same sort of specific definition as the method detection limit and is based on the reliability of the measurements and the specific uses of the data (Childress and others, 1999).

Quality Assurance and Quality Control

Analytical results should describe the environmental conditions at the time the samples were collected. Unfortunately, problems such as sampling error, contamination, degradation, and analytical error can affect the process and ultimately lead to analytical results that are not representative of the natural conditions. Several techniques, collectively known as quality assurance and quality control, were used to evaluate the precision and accuracy of the reported analytical results for this study. Quality-assurance samples collected during the study included field equipment blank samples and replicate samples. Analytical results for the quality-assurance samples are presented in the tables along with the analytical results for the environmental samples.

During the June 2005 sampling, three quality-assurance water samples were collected, including one field equipment blank sample and two replicate samples. During the July 2005 sampling, one field equipment blank sample (water only) and one replicate sample (water and bottom sediment) were collected.

In addition to the quality-assurance samples collected during the study, matrix spike samples were prepared by the WDML as part of method performance for mercury concentrations to test for internal precision and accuracy of the method as described in DeWild and others (2002). The percent recoveries for both the matrix spike and matrix spike duplicates for the results for methylmercury concentrations dissolved in water did not meet the data-quality objectives of percent recoveries between 75 percent and 125 percent; thus, actual dissolved methylmercury concentrations may be greater than 25 percent higher or lower than the reported values.

Field Equipment Blank Samples

Field equipment blank samples are used to assess the possible contamination of samples or analytical error. The blank samples were collected in the field by processing laboratory-grade blank water and using the same procedures and equipment used to collect the environmental samples. The blank samples were collected at the same location as the environmental sample and just before the environmental samples were collected. If no contamination of the sample is introduced during the collection, processing, transport, and analysis of the blank sample, and the analytical results are accurate, then none of the constituents should be detected. If the analytical results indicate that the field equipment blank has constituent concentrations greater than the laboratory-grade blank water, then it may be an indication that the sample was contaminated during the process or that the analytical technique is overestimating the analyte of interest.

One set of field equipment blank samples was collected during both June and July for water samples (table 3). The June field equipment blank was collected at wetland G on June 16, the last day of the June sampling. The July field equipment blank was collected at wetland Q on July 11, the first day of the July sampling. The June blank sample was analyzed for pesticides. The July blank sample was analyzed for major ions, organic carbon, and mercury species.

With only a few field equipment blank samples collected, comparisons are difficult. A few minor detections were reported in the blank samples, but the reported concentrations were fairly small. No pesticides or major ions were detected in blank samples. Some organic carbon and mercury species were detected in blank samples, but at concentrations one to two orders of magnitude less than environmental samples. The results for the blank samples indicate that the sampling and analytical methods did not contaminate the samples or produce false detections.

Replicate Samples

A replicate sample is intended to be an exact copy of the environmental sample. It is collected soon after the environmental sample using the same equipment, uncleaned, and it is processed and transported with the environmental sample. Any differences in the analytical results between the environmental sample and the replicate sample may indicate some combination of inconsistency of sample collection, the natural variability in the sampled water, and the variability of the analytical method.

During the June sampling, a pair of samples was collected at two sites, wetlands J and N (table 3). At each site, the first sample collected is referred to as the environmental sample, and the second sample is referred to as the replicate sample. During the July sampling, environmental and replicate samples were collected at wetland F. With only a few replicate samples collected, comparisons are difficult. Some minor differences in concentrations between the environmental and replicate samples were reported for major ions, organic carbon, pesticides, and mercury species, but reported results are fairly consistent. Most pesticides detected in paired samples were detected in both the environmental and replicate samples. The general agreement between the results for the environmental and replicate samples indicates consistency in the sampling methods and in the analytical methods.

Quality of Water in Wetlands

The samples collected for this study were analyzed for more than 100 physical properties and chemical constituents. The quality of the water in the Yankton Sioux wetlands in eastern Charles Mix County cannot be thoroughly characterized with the few samples collected within a 2-month period, but selected water-quality characteristics are described in this section.

Physical Properties

Samples collected for this study were analyzed for the physical properties presented in table 4. The results show that a wide range of conditions were represented by the wetlands and that properties such as specific conductance varied greatly from wetland to wetland during the June and July sampling. Specific conductance for the June 2005 samples ranged from 188 µS/cm (wetland J) to 6,420 µS/cm (wetland B), with a median of 499 µS/cm.

For the eight wetlands at which samples were collected during both June and July 2005, properties such as specific conductance and temperature varied greatly for some of the individual wetlands. Specific conductance ranged from 354 µS/cm (wetland K) to 4,977 µS/cm (wetland C), with a median of 807 µS/cm in June, and from 284 µS/cm (wetland K) to 5,540 µS/cm (wetland C), with a median of 1,420 µS/cm in July. Water temperature ranged from 15.4°C (wetlands Q and R) to 23.9°C (wetland C), with a median of 18.5°C in June, and from 22.1°C (wetland O) to 34.6°C (wetland N), with a median of 26.6°C in July.

Major Ions

Samples from 10 selected Yankton Sioux Tribe wetlands were collected during June–July 2005 and analyzed for dissolved concentrations of eight major ions (table 5). The results show that some major ion concentrations varied greatly from wetland to wetland and that the wetlands represent a wide range of conditions. For example, dissolved calcium concentrations ranged from 27.4 to 506 mg/L; dissolved magnesium concentrations ranged from 7.92 to 491 mg/L; dissolved sodium concentrations ranged from 1.63 to 660 mg/L; and dissolved sulfate concentrations ranged from 3.13 to 3,610 mg/L (table 5).

Sulfate concentrations are particularly important in mercury chemistry because methylation of mercury occurs as a by-product of sulfate reduction. Very high rates of sulfate reduction can result in an accumulation of sulfide, which can strongly bind mercury ions and make them unavailable for methylation of mercury (Sando and others, 2003). Thus, although sulfate concentrations must be greater than about 2 mg/L for sulfate reduction to occur (Gilmour and Krabbenhoft, 2001), relatively large sulfate concentrations of greater than about 50 mg/L (National Oceanic and Atmospheric Administration, 1996) can sometimes provide accumulation of sulfide and inhibit methylation of mercury. For this study, sulfate concentrations generally were much greater than the minimum concentration required for sulfate reduction and generally were greater than the concentrations reported to inhibit methylation of mercury.

Table 4. Physical properties of water in selected Yankton Sioux Tribe wetlands, June–July 2005.

[NTU, nephelometric turbidity units; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg C, degrees Celsius; FET, fixed end point titration; --, no data. Number in parenthesis below property is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Water depth (meters) (82903)	Transparency (secchi disk) (inches) (00077)	Turbidity (NTU) (63680)	Oxygen, dissolved (mg/L) (00300)	pH, whole field (standard units) (00400)	Specific conductance (µS/cm) (00095)	Temperature water (deg C) (00010)	Temperature air (deg C) (00020)	Alkalinity, dissolved total FET field (mg/L as $CaCO_3$) (39086)
A	431907098321000	06-14-2005	0955	0.1	4	7.1	2.52	7.85	1,430	16.8	19	200
B	431853098322600	06-14-2005	0830	.36	14	22.5	5.81	8.1	6,420	15.7	21	288
C	431759098334000	06-16-2005	1545	1.14	45	10	13.1	8.74	4,977	23.9	29	--
C	431759098334000	07-13-2005	1200	.76	30	1.1	2.63	8.04	5,540	27.5	32	165
D	431426098345800	06-16-2005	1455	.08	3	31.6	10.4	7.87	2,246	30.3	32	--
E	431116098355600	06-16-2005	1405	.1	4	105.6	2	6.46	313	23.8	36	--
F	430735098193000	06-13-2005	1115	.92	7	104	5.35	6.86	1,114	18.3	25	--
F	430735098193000	07-11-2005	1315	.59	5	306.2	4.87	7.55	3,362	26.8	45	353
F[1]	430735098193000	07-11-2005	1320	--	--	--	--	7.93	3,360	26.8	45	363
G	430618098275800	06-16-2005	1300	.06	2.5	28	2.96	6.93	545	27.3	30	--
H	430500098064000	06-13-2005	1445	.31	12	12.1	4.19	6.76	1,114	19.1	31	--
H	430500098064000	07-12-2005	0925	.23	6	10.5	.6	6.56	1,119	28	22.3	200
I	430443098102200	06-13-2005	1215	.22	5	126	1.5	6.52	221	20	27	--
J	430335098254800	06-16-2005	0755	.1	4	101	3.18	6.5	188	17.3	18	--
J[1]	430335098254800	06-16-2005	0800	.1	4	101	3.18	6.5	188	17.3	18	--
K	430311098253000	06-16-2005	1650	.92	--	17.3	--	6.91	354	22.9	30	--
K	430311098253000	07-12-2005	1145	.31	11	20.3	.9	6.69	284	23	29	117
L	430300098253300	06-16-2005	0800	--	--	149	1.3	6.73	258	27.5	34	--
M	430300098243400	06-15-2005	1655	.1	4	87.5	1.26	6.36	223	23.6	34	--
N	430226098281400	06-16-2005	0840	.36	14	22.8	3.78	7.18	2,460	18.1	19	--
N[1]	430226098281400	06-16-2005	0845	--	--	--	--	7.2	2,460	--	--	--
N	430226098281400	07-12-2005	1330	.05	2	43.7	6.04	7.4	1,720	34.6	34	138

Table 4. Physical properties of water in selected Yankton Sioux Tribe wetlands, June–July 2005.—Continued

[NTU, nephelometric turbidity units; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg C, degrees Celsius; FET, fixed end point titration; --, no data. Number in parenthesis below property is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Water depth (meters) (82903)	Transparency (secchi disk) (inches) (00077)	Turbidity (NTU) (63680)	Oxygen, dissolved (mg/L) (00300)	pH, whole field (standard units) (00400)	Specific conductance (µS/cm) (00095)	Temperature water (deg C) (00010)	Temperature air (deg C) (00020)	Alkalinity, dissolved total FET field (mg/L as $CaCO_3$) (39086)
O	430202098230300	06-15-2005	1635	0.1	4	14.9	1.99	6.73	471	17.5	24	--
O	430202098230300	07-13-2005	0950	.03	1	314.1	.62	6.47	504	22.1	24	170
P	430125098120600	06-13-2005	1540	.15	6	25.2	1.34	6.81	499	18.8	26	--
P	430125098120600	07-12-2005	1035	.56	7.5	74.5	.54	6.66	286	25.4	28	119
Q	425941098173400	06-15-2005	0835	.13	5	418	2.6	6.63	500	15.4	19	--
Q	425941098173400	07-11-2005	1130	.31	2	692	3.1	6.96	1,750	26.4	31	476
R	425740098161100	06-15-2005	0915	.19	7.5	14	2.89	6.56	250	15.4	19.5	--
S	425631098181600	06-15-2005	0945	.1	4	29.1	1.51	6.62	270	17.2	24	--

[1] Replicate sample.

Table 5. Dissolved concentrations of major ions in water samples from selected Yankton Sioux Tribe wetlands, June–July 2005.

[mg/L, milligrams per liter; <, less than laboratory reporting level; E, estimated. Number in parenthesis below constituent is National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Calcium, in mg/L (00915)	Magnesium, in mg/L (00925)	Potassium, in mg/L (00935)	Sodium, in mg/L (00930)	Chloride, in mg/L (00940)	Fluoride, in mg/L (00950)	Silica, in mg/L (00955)	Sulfate, in mg/L (00945)
A	431907098321000	06-14-2005	0955	216	62.5	39.9	10.5	1.01	E0.1	33.4	609
B	431853098322600	06-14-2005	0830	384	491	99.3	660	202	.24	25.7	3,610
C	431759098334000	07-13-2005	1200	267	404	120	636	171	.18	24.3	3,130
F	430735098193000	07-11-2005	1315	506	197	35.3	145	43.2	.36	13.5	1,830
F[1]	430735098193000	07-11-2005	1320	501	196	35.3	144	43.4	.36	13.5	1,840
H	430500098064000	07-12-2005	0925	123	63.7	14.8	23.4	5.45	.22	112	396
K	430311098253000	07-12-2005	1145	27.4	7.93	23.5	1.63	4.56	.10	23.9	3.19
N	430226098281400	07-12-2005	1330	347	138	27.2	89.2	74.9	.53	9.09	1,400
O	430202098230300	07-13-2005	0950	42.4	11.9	20.2	5.4	3.26	.19	39	9.11
P	430125098120600	07-12-2005	1035	29.6	7.92	18	1.63	5.95	.12	73.5	3.13
Q[2]	425941098173400	07-11-2005	1125	<.02	<.008	<.16	<.20	<.20	<.10	<.20	<.18
Q	425941098173400	07-11-2005	1130	229	86.2	36.1	64.9	26.4	.25	23.6	540

[1] Replicate sample.

[2] Blank sample.

Organic Carbon

The presence of organic carbon is one of the factors needed for the methylation of mercury to occur. Samples from 10 selected Yankton Sioux Tribe wetlands were collected during June–July 2005 and analyzed for the total organic carbon and dissolved organic carbon (table 6). Concentrations for total organic carbon ranged from 25.1 mg/L (wetland N) to an estimated 210 mg/L (wetland C), with a median of 41.2 mg/L. Concentrations for dissolved organic carbon ranged from 8.8 mg/L (wetland F) to 72 mg/L (wetland Q), with a median of 30 mg/L.

Pesticides

Water samples collected from 19 Yankton Sioux Tribe wetlands in June 2005 were analyzed for dissolved concentrations of 61 pesticides (table 7). All of the samples were filtered in the field. Of the 61 pesticides, 48 were not detected in any of the samples. Of the 13 detected pesticides (fig. 5), many were detected only at low concentrations in a few of the samples.

Atrazine and the atrazine metabolite, de-ethyl atrazine, were detected at each of the wetlands. The minimum dissolved atrazine concentration of 0.056 µg/L was found at wetland N, as was the minimum dissolved de-ethyl atrazine concentration of 0.018 µg/L. The maximum dissolved atrazine concentration of 0.567 µg/L was found in wetland L, as was the maximum dissolved de-ethyl atrazine concentration of 0.377 µg/L (tables 7 and 8). The median dissolved atrazine and de-ethyl atrazine concentrations were 0.151 and 0.051 µg/L, respectively (table 8). Four of the pesticides (alachlor, carbaryl, chlorpyrifos, and dicamba) were detected in only one wetland each, but the wetlands in which those pesticides were detected, P, K, O, and R, respectively, had 5 to 8 pesticides detected in them (fig. 6).

The minimum number of pesticides detected in any wetland was three (wetlands E and N) (fig. 6). Atrazine and de-ethyl atrazine were detected in every wetland, so they account for 2 of the 3 pesticides detected in wetlands E and N, but for wetland E, the third pesticide was glyphosate and for wetland N, the third pesticide was metolachlor. The maximum number of pesticides detected in any wetland was eight (wetlands P and R). Six pesticides (2,4-D, acetochlor, AMPA, atrazine, de-ethyl atrazine, and metolachlor) were detected in both wetlands P and R. The 2 other pesticides detected in wetlands P were alachlor and picloram, and the other 2 pesticides detected in wetland R were dicamba and glyphosate. A median of six pesticides was detected in the individual wetlands.

Table 6. Organic carbon concentrations in water samples from selected Yankton Sioux Tribe wetlands, June–July 2005.

[mg/L, milligrams per liter; E, estimated. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Total organic carbon, in mg/L (00680)	Dissolved organic carbon, in mg/L (00681)
A	431907098321000	06-14-2005	0955	49.6	29
B	431853098322600	06-14-2005	0830	49.9	44
C	431759098334000	07-13-2005	1200	E210	37
F	430735098193000	07-11-2005	1315	27.1	8.8
F[1]	430735098193000	07-11-2005	1320	29.7	9.0
H	430500098064000	07-12-2005	0925	44.9	34
K	430311098253000	07-12-2005	1145	27.1	24
N	430226098281400	07-12-2005	1330	25.1	17
O	430202098230300	07-13-2005	0950	37.5	30
P	430125098120600	07-12-2005	1035	34.4	21
Q[2]	425941098173400	07-11-2005	1125	E.39	.6
Q	425941098173400	07-11-2005	1130	E191	72

[1] Replicate sample.

[2] Blank sample.

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; E, estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	2,4,5-T (39742)	2,4-D (39732)	2,6-Diethyl analine (82660)	Acetochlor (49260)	Alachlor (46342)	alpha-HCH (34253)	AMPA (62649)	Atrazine (39632)	Azinphos-methyl (82686)	Benfluralin (82673)	Butylate (04028)
A	431907098321000	06-14-2005	0955	<0.03	<0.02	<0.006	<0.009	<0.005	<0.005	<0.1	0.151	<0.050	<0.010	<0.004
B	431853098322600	06-14-2005	0830	<.03	.06	<.006	<.006	<.005	<.005	<.1	.103	<.050	<.010	<.004
C	431759098334000	06-16-2005	1545	<.03	E.05	<.006	<.006	<.005	<.005	<.1	.133	<.050	<.010	<.004
D	431426098345800	06-16-2005	1455	<.03	.85	<.006	<.006	<.005	<.005	.2	.420	<.050	<.010	<.004
E	431116098355600	06-16-2005	1405	<.03	<.02	<.006	<.007	<.005	<.005	<.1	.123	<.050	<.010	<.004
F	430735098193000	06-13-2005	1115	<.03	.16	<.006	.017	<.005	<.005	.3	.309	<.050	<.010	<.004
G[1]	430618098275800	06-16-2005	1255	<.03	<.02	<.006	<.006	<.005	<.005	<.1	<.007	<.050	<.010	<.004
G	430618098275800	06-16-2005	1300	<.03	<.02	<.006	<.009	<.005	<.005	<.1	.171	<.050	<.010	<.004
H	430500098064000	06-13-2005	1445	<.03	.06	<.006	.022	<.005	<.005	<.1	.157	<.050	<.010	<.004
I	430443098102200	06-13-2005	1215	<.03	.04	<.006	.019	<.020	<.005	<.1	.196	<.050	<.010	<.004
J	430335098254800	06-16-2005	0755	<.03	E.02	<.006	<.014	<.005	<.005	.3	.124	<.050	<.010	<.004
J[2]	430335098254800	06-16-2005	0800	<.03	<.02	<.006	<.011	<.005	<.005	.3	.123	<.050	<.010	<.004
K	430311098253000	06-16-2005	1650	<.03	E.02	<.006	<.010	<.005	<.005	.4	.124	<.050	<.010	<.004
L	430300098253300	06-16-2005	0800	<.03	.12	<.006	.022	<.005	<.005	.4	.567	<.050	<.010	<.004
M	430300098243400	06-15-2005	1655	<.03	<.02	<.006	.018	<.005	<.005	.3	.123	<.050	<.010	<.004
N	430226098281400	06-16-2005	0840	<.03	<.02	<.006	<.006	<.005	<.005	<.1	.056	<.050	<.010	<.004
N[2]	430226098281400	06-16-2005	0845	<.03	<.02	<.006	<.006	<.005	<.005	<.1	.050	<.050	<.010	<.004
O	430202098230300	06-15-2005	1635	<.03	.03	<.006	.015	<.005	<.005	<.1	.122	<.050	<.010	<.004
P	430125098120600	06-13-2005	1540	<.03	.07	<.006	.039	.009	<.005	.3	.227	<.050	<.010	<.004
Q	425941098173400	06-15-2005	0835	<.03	<.02	<.006	<.010	<.005	<.005	<.1	.150	<.060	<.010	<.004
R	425740098161100	06-15-2005	0915	<.03	.06	<.006	.021	<.005	<.005	1.5	.166	<.050	<.010	<.004
S	425631098181600	06-15-2005	0945	<.03	<.02	<.006	.011	<.005	<.005	.1	.180	<.060	<.010	<.004

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; E, estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Carbaryl (82680)	Carbo-furan (82674)	Chlor-pyrifos (38933)	*cis*-Perme-thrin (82687)	Cyan-azine (04041)	DCPA (82682)	De-ethyl atrazine (04040)	Desulfinyl-fipronil (62170)	Desulfinyl-fipronil-amide (62169)	Diazinon (39572)
A	431907098321000	06-14-2005	0955	<0.041	<0.020	<0.005	<0.006	<0.018	<0.003	E0.051	<0.012	<0.029	<0.005
B	431853098322600	06-14-2005	0830	<.041	<.020	<.005	<.006	<.018	<.003	E.024	<.012	<.029	<.005
C	431759098334000	06-16-2005	1545	<.041	<.020	<.005	<.006	<.018	<.003	E.028	<.012	<.029	<.005
D	431426098345800	06-16-2005	1455	<.041	<.020	<.005	<.006	<.018	<.003	E.113	<.012	<.029	<.005
E	431116098355600	06-16-2005	1405	<.041	<.020	<.005	<.006	<.018	<.003	E.029	<.012	<.029	<.017
F	430735098193000	06-13-2005	1115	<.041	<.020	<.005	<.006	<.018	<.003	E.080	<.012	<.029	<.005
G[1]	430618098275800	06-16-2005	1255	<.041	<.020	<.005	<.006	<.018	<.003	<.006	<.012	<.029	<.005
G	430618098275800	06-16-2005	1300	<.041	<.020	<.005	<.006	<.018	<.003	E.047	<.012	<.029	<.005
H	430500098064000	06-13-2005	1445	<.041	<.020	<.005	<.006	<.018	<.003	E.056	<.012	<.029	<.005
I	430443098102200	06-13-2005	1215	<.041	<.020	<.005	<.006	<.018	<.003	E.067	<.012	<.029	<.005
J	430335098254800	06-16-2005	0755	<.041	<.020	<.005	<.006	<.018	<.003	E.037	<.012	<.029	<.005
J[2]	430335098254800	06-16-2005	0800	<.041	<.020	<.005	<.006	<.018	<.003	E.038	<.012	<.029	<.005
K	430311098253000	06-16-2005	1650	E.130	<.020	<.005	<.006	<.018	<.003	E.031	<.012	<.029	<.005
L	430300098253300	06-16-2005	0800	<.041	<.020	<.005	<.006	<.018	<.003	E.377	<.012	<.029	<.005
M	430300098243400	06-15-2005	1655	<.041	<.020	<.005	<.006	<.018	<.003	E.051	<.012	<.029	<.005
N	430226098281400	06-16-2005	0840	<.041	<.020	<.005	<.006	<.018	<.003	E.018	<.012	<.029	<.005
N[2]	430226098281400	06-16-2005	0845	<.041	<.020	<.005	<.006	<.018	<.003	E.013	<.012	<.029	<.005
O	430202098230300	06-15-2005	1635	<.041	<.020	.043	<.006	<.018	<.003	E.044	<.012	<.029	<.005
P	430125098120600	06-13-2005	1540	<.041	<.020	<.005	<.006	<.018	<.003	E.066	<.012	<.029	<.005
Q	425941098173400	06-15-2005	0835	<.041	<.020	<.005	<.006	<.018	<.003	E.049	<.012	<.029	<.005
R	425740098161100	06-15-2005	0915	<.041	<.020	<.005	<.006	<.018	<.003	E.061	<.012	<.029	<.005
S	425631098181600	06-15-2005	0945	<.041	<.020	<.005	<.006	<.018	<.003	E.064	<.012	<.029	<.005

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Dicamba (38442)	Dichlor-prop (82356)	Dieldrin (39381)	Disulfoton (82677)	EPTC (82668)	Ethal-fluralin (82663)	Ethoprop (82672)	Fipronil (62166)	Fipronil sulfide (62167)	Fipronil sulfone (62168)
A	431907098321000	06-14-2005	0955	<0.03	0.02	<0.009	<0.02	<0.004	<0.009	<0.005	<0.016	<0.013	<0.024
B	431853098322600	06-14-2005	0830	<.03	.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
C	431759098334000	06-16-2005	1545	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
D	431426098345800	06-16-2005	1455	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
E	431116098355600	06-16-2005	1405	<.03	<.02	<.080	<.02	<.004	<.009	<.005	<.016	<.013	<.024
F	430735098193000	06-13-2005	1115	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
G[1]	430618098275800	06-16-2005	1255	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
G	430618098275800	06-16-2005	1300	<.03	<.02	<.050	<.02	<.004	<.009	<.005	<.016	<.013	<.024
H	430500098064000	06-13-2005	1445	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
I	430443098102200	06-13-2005	1215	<.03	.13	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
J	430335098254800	06-16-2005	0755	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
J[2]	430335098254800	06-16-2005	0800	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
K	430311098253000	06-16-2005	1650	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
L	430300098253300	06-16-2005	0800	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
M	430300098243400	06-15-2005	1655	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
N	430226098281400	06-16-2005	0840	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
N[2]	430226098281400	06-16-2005	0845	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
O	430202098230300	06-15-2005	1635	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
P	430125098120600	06-13-2005	1540	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
Q	425941098173400	06-15-2005	0835	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
R	425740098161100	06-15-2005	0915	.05	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024
S	425631098181600	06-15-2005	0945	<.03	<.02	<.009	<.02	<.004	<.009	<.005	<.016	<.013	<.024

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Fonofos (04095)	Glufo-sinate (62721)	Gly-phosate (62722)	Lindane (39341)	Linuron (82666)	Malathion (39532)	Meto-lachlor (39415)	Metribuzin (82630)	Molinate (82671)	Naprop-amide (82684)
A	431907098321000	06-14-2005	0955	<0.003	<0.1	<0.1	<0.004	<0.035	<0.027	0.015	<0.006	<0.003	<0.007
B	431853098322600	06-14-2005	0830	<.003	<.1	.1	<.004	<.035	<.027	<.009	<.006	<.003	<.007
C	431759098334000	06-16-2005	1545	<.003	<.1	<.1	<.004	<.035	<.027	.017	<.006	<.003	<.007
D	431426098345800	06-16-2005	1455	<.003	<.1	.2	<.004	<.035	<.027	.024	<.006	<.003	<.007
E	431116098355600	06-16-2005	1405	<.003	<.1	.1	<.005	<.035	<.027	<.028	<.006	<.003	<.007
F	430735098193000	06-13-2005	1115	<.003	<.1	<.1	<.004	<.035	<.027	.020	<.006	<.003	<.007
G[1]	430618098275800	06-16-2005	1255	<.003	<.1	<.1	<.004	<.035	<.027	<.0006	<.006	<.003	<.007
G	430618098275800	06-16-2005	1300	<.003	<.1	<.1	<.004	<.035	<.159	.032	<.006	<.003	<.007
H	430500098064000	06-13-2005	1445	<.003	<.1	.1	<.004	<.035	<.027	.031	<.006	<.003	<.007
I	430443098102200	06-13-2005	1215	<.003	<.1	<.1	<.004	<.035	<.027	E.046	<.006	<.003	<.007
J	430335098254800	06-16-2005	0755	<.011	<.1	<.1	<.004	<.035	<.414	.037	<.006	<.003	<.007
J[2]	430335098254800	06-16-2005	0800	<.011	<.1	<.1	<.004	<.035	<.382	.039	<.006	<.003	<.007
K	430311098253000	06-16-2005	1650	<.003	<.1	.2	<.004	<.035	<.027	.034	<.006	<.003	<.007
L	430300098253300	06-16-2005	0800	<.003	<.1	<.1	<.004	<.035	<.027	.040	<.006	<.003	<.007
M	430300098243400	06-15-2005	1655	<.003	<.1	.7	<.004	<.035	<.027	.037	<.006	<.003	<.007
N	430226098281400	06-16-2005	0840	<.003	<.1	<.1	<.004	<.035	<.027	.006	<.006	<.003	<.007
N[2]	430226098281400	06-16-2005	0845	<.003	<.1	<.1	<.004	<.035	<.027	E.006	<.006	<.003	<.007
O	430202098230300	06-15-2005	1635	<.003	<.1	<.1	<.004	<.035	<.027	.026	<.006	<.003	<.007
P	430125098120600	06-13-2005	1540	<.003	<.1	<.1	<.004	<.035	<.027	1.89	<.006	<.003	<.007
Q	425941098173400	06-15-2005	0835	<.003	<.1	.2	<.004	<.035	<.027	E.039	<.006	<.003	<.007
R	425740098161100	06-15-2005	0915	<.003	<.1	.4	<.004	<.035	<.027	.037	<.006	<.003	<.007
S	425631098181600	06-15-2005	0945	<.003	<.1	<.1	<.004	<.035	<.027	.030	<.006	<.003	<.007

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	p,p′-DDE (34653)	Parathion (39542)	Methyl-parathion (82667)	Pebulate (82669)	Pendi-methalin (82683)	Phorate (82664)	Picloram (49291)	Prometon (04037)	Propyz-amide (82676)	Propa-chlor (04024)
A	431907098321000	06-14-2005	0955	<0.026	<0.010	<0.015	<0.004	<0.022	<0.011	<0.20	<0.01	<0.005	<0.025
B	431853098322600	06-14-2005	0830	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
C	431759098334000	06-16-2005	1545	<.003	<.010	<.015	<.004	<.022	<.011	.13	<.01	<.004	<.025
D	431426098345800	06-16-2005	1455	<.007	<.010	<.015	<.004	<.022	<.011	.88	<.01	<.009	<.025
E	431116098355600	06-16-2005	1405	<.004	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
F	430735098193000	06-13-2005	1115	<.003	<.010	<.015	<.004	<.022	<.011	.31	<.01	<.004	<.025
G[1]	430618098275800	06-16-2005	1255	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
G	430618098275800	06-16-2005	1300	<.003	<.010	<.015	<.004	<.022	<.011	E.03	<.01	<.004	<.025
H	430500098064000	06-13-2005	1445	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
I	430443098102200	06-13-2005	1215	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
J	430335098254800	06-16-2005	0755	<.007	<.010	<.015	<.004	<.022	<.011	E.02	<.01	<.004	<.025
J[2]	430335098254800	06-16-2005	0800	<.008	<.010	<.015	<.004	<.022	<.011	E.03	<.01	<.004	<.025
K	430311098253000	06-16-2005	1650	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
L	430300098253300	06-16-2005	0800	<.003	<.010	<.015	<.004	<.022	<.011	.28	<.01	<.004	<.025
M	430300098243400	06-15-2005	1655	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
N	430226098281400	06-16-2005	0840	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
N[2]	430226098281400	06-16-2005	0845	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
O	430202098230300	06-15-2005	1635	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
P	430125098120600	06-13-2005	1540	<.003	<.010	<.015	<.004	<.022	<.011	.05	<.01	<.004	<.025
Q	425941098173400	06-15-2005	0835	<.003	<.010	<.015	<.004	<.022	<.011	.07	<.01	<.004	<.025
R	425740098161100	06-15-2005	0915	<.003	<.010	<.015	<.004	<.022	<.011	<.04	<.01	<.004	<.025
S	425631098181600	06-15-2005	0945	<.003	<.010	<.015	<.004	<.022	<.011	E.01	<.01	<.004	<.025

Table 7. Dissolved pesticide concentrations in water samples from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[Concentrations in micrograms per liter and all water samples were filtered prior to analysis; <, less than laboratory reporting level; estimated; --, no data. Shaded cells indicate concentrations greater than or equal to the laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Site (fig. 2)	Station number	Date	Time	Propanil (82679)	Propar-gite (82685)	Silvex (39762)	Simazine (04035)	Tebuthiuron (82670)	Terbacil (82665)	Terbufos (82675)	Thioben-carb (82681)	Triallate (82674)	Trifluralin (82661)
A	431907098321000	06-14-2005	0955	<0.011	<0.02	<0.03	<0.005	<0.02	<0.034	<0.02	<0.010	<0.006	<0.009
B	431853098322600	06-14-2005	0830	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
C	431759098334000	06-16-2005	1545	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
D	431426098345800	06-16-2005	1455	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
E	431116098355600	06-16-2005	1405	<0.011	<.05	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
F	430735098193000	06-13-2005	1115	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
G[1]	430618098275800	06-16-2005	1255	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
G	430618098275800	06-16-2005	1300	<0.011	<.02	<.03	<.005	<.02	<.046	<.02	<.010	<.006	<.009
H	430500098064000	06-13-2005	1445	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
I	430443098102200	06-13-2005	1215	<0.011	--	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
J	430335098254800	06-16-2005	0755	<0.011	<.08	<.03	<.005	<.02	<.051	<.02	<.010	<.006	<.009
J[2]	430335098254800	06-16-2005	0800	<0.011	<.08	<.03	<.005	<.02	<.050	<.02	<.010	<.006	<.009
K	430311098253000	06-16-2005	1650	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
L	430300098253300	06-16-2005	0800	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
M	430300098243400	06-15-2005	1655	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
N	430226098281400	06-16-2005	0840	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
N[2]	430226098281400	06-16-2005	0845	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
O	430202098230300	06-15-2005	1635	<0.011	<.02	<.03	<.005	<.02	<.040	<.02	<.010	<.006	<.009
P	430125098120600	06-13-2005	1540	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
Q	425941098173400	06-15-2005	0835	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
R	425740098161100	06-15-2005	0915	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009
S	425631098181600	06-15-2005	0945	<0.011	<.02	<.03	<.005	<.02	<.034	<.02	<.010	<.006	<.009

[1] Blank.

[2] Replicate.

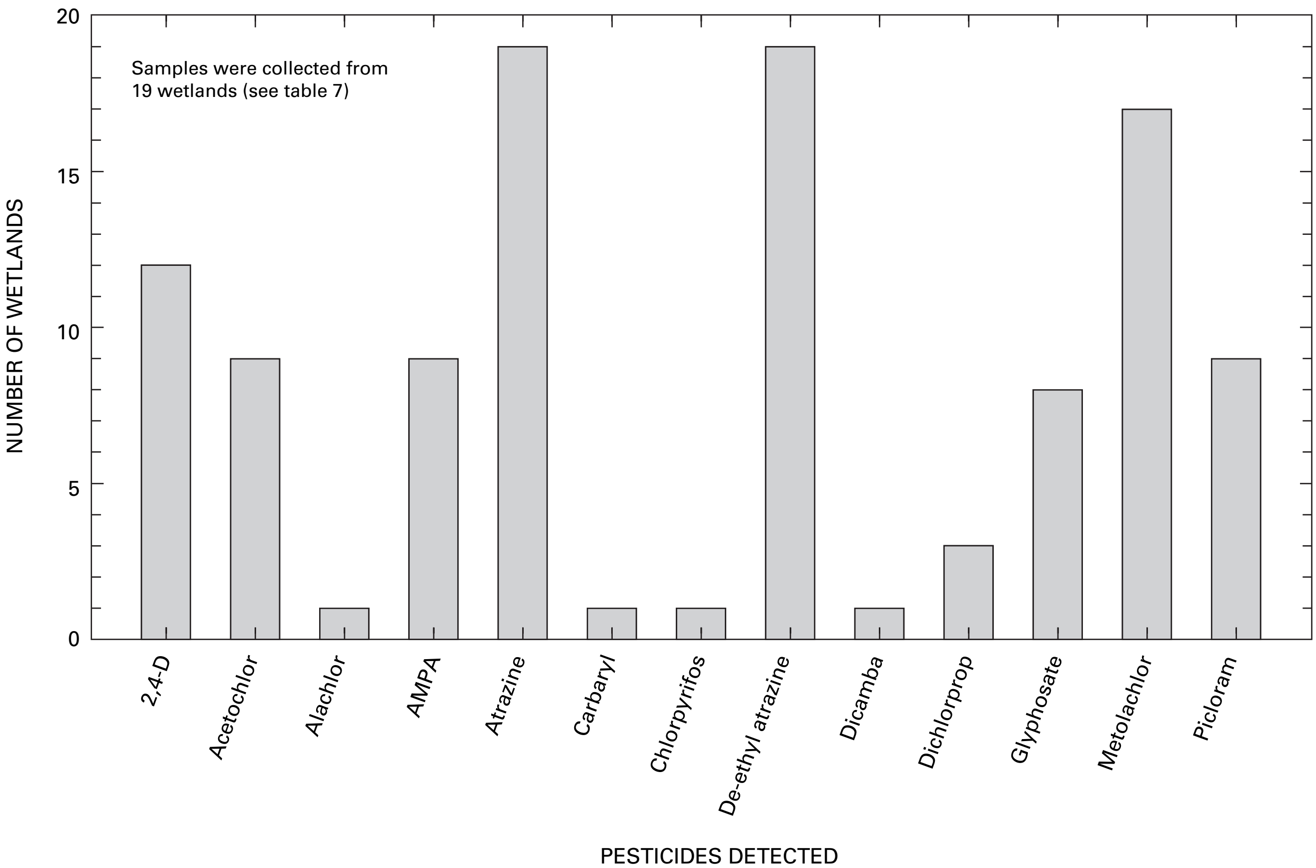

Figure 5. Number of Yankton Sioux Tribe wetlands at which selected pesticides were detected, June 2005.

Table 8. Statistical summary of dissolved pesticide concentrations in water samples collected from selected Yankton Sioux Tribe wetlands, June 2005.

[NWIS, U.S. Geological Survey National Water Information System; µg/L, micrograms per liter; NA, not applicable. Shaded rows indicate those pesticides detected in at least one wetland.]

Constituent	NWIS parameter code	Laboratory reporting level (µg/L)	Number of samples	Number of detections	Detection frequency, in percent	Minimum concentration of detections (µg/L)	Maximum concentration of detections (µg/L)	Median concentration of detections (µg/L)
2,4,5-T	39742	0.03	19	0	0	NA	NA	NA
2,4-D	39732	.02	19	12	63	0.02	0.85	0.06
2,6-Diethylaniline	82660	.006	19	0	0	NA	NA	NA
Acetochlor	49260	.006 .007 .009 .010 .014	19	9	47	.011	.039	.019
Alachlor	46342	.005	19	1	5	.009	.009	.009
alpha-HCH	34253	.005	19	0	0	NA	NA	NA
AMPA	62649	.1	19	9	47	.1	1.5	.3
Atrazine	39632	.007	19	19	100	.056	.567	.151

Table 8. Statistical summary of dissolved pesticide concentrations in water samples collected from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[NWIS, U.S. Geological Survey National Water Information System; µg/L, microgram per liter; NA, not applicable. Shaded rows indicate those pesticides detected in at least one wetland.]

Constituent	NWIS parameter code	Laboratory reporting level (µg/L)	Number of samples	Number of detections	Detection frequency, in percent	Minimum concentration of detections (µg/L)	Maximum concentration of detections (µg/L)	Median concentration of detections (µg/L)
Azinphos-methyl	82686	0.050 .060	19	0	0	NA	NA	NA
Benfluralin	82673	.010	19	0	0	NA	NA	NA
Butylate	04028	.004	19	0	0	NA	NA	NA
Carbaryl	82680	.041	19	1	5	.13	.13	.13
Carbofuran	82674	.020	19	0	0	NA	NA	NA
Chlorpyrifos	38933	.005	19	1	5	.043	.043	.043
cis-Permethrin	82687	.006	19	0	0	NA	NA	NA
Cyanazine	04041	.018	19	0	0	NA	NA	NA
Dacthal	82682	.003	19	0	0	NA	NA	NA
De-ethyl atrazine	04040	.006	19	19	100	.018	.377	.051
Desulfinyl-fipronil	62170	.012	19	0	0	NA	NA	NA
Desulfinyl-fipronilamide	62169	.029	19	0	0	NA	NA	NA
Diazinon	39572	.005 .017	19	0	0	NA	NA	NA
Dicamba	38442	.03	19	1	5	.05	.05	.05
Dichlorprop	82356	.02	19	3	16	.02	.13	.02
Dieldrin	39381	.009 .080 .050	19	0	0	NA	NA	NA
Disulfoton	82677	.02	19	0	0	NA	NA	NA
EPTC	82668	.004	19	0	0	NA	NA	NA
Ethalfluralin	82663	.009	19	0	0	NA	NA	NA
Ethoprophos	82672	.005	19	0	0	NA	NA	NA
Fipronil	62166	.016	19	0	0	NA	NA	NA
Fipronil sulfide	62167	.013	19	0	0	NA	NA	NA
Fipronil sulfone	62168	.024	19	0	0	NA	NA	NA
Fonofos	04095	.003 .011	19	0	0	NA	NA	NA
Glufosinate	62721	.1	19	0	0	NA	NA	NA
Glyphosate	62722	.1	19	8	42	.1	.7	.2
Lindane	39341	.004 .005	19	0	0	NA	NA	NA
Linuron	82666	.035	19	0	0	NA	NA	NA
Malathion	39532	.027 .159 .414	19	0	0	NA	NA	NA

Table 8. Statistical summary of dissolved pesticide concentrations in water samples collected from selected Yankton Sioux Tribe wetlands, June 2005.—Continued

[NWIS, U.S. Geological Survey National Water Information System; µg/L, microgram per liter; NA, not applicable. Shaded rows indicate those pesticides detected in at least one wetland.]

Constituent	NWIS parameter code	Laboratory reporting level (µg/L)	Number of samples	Number of detections	Detection frequency, in percent	Minimum concentration of detections (µg/L)	Maximum concentration of detections (µg/L)	Median concentration of detections (µg/L)
Metolachlor	39415	0.009 .028	19	17	89	0.006	1.89	0.032
Metribuzin	82630	.006	19	0	0	NA	NA	NA
Molinate	82671	.003	19	0	0	NA	NA	NA
Napropamide	82684	.007	19	0	0	NA	NA	NA
p,p'-DDE	34653	.003 .004 .007 .026	19	0	0	NA	NA	NA
Parathion	39542	.010	19	0	0	NA	NA	NA
Parathion-methyl	82667	.015	19	0	0	NA	NA	NA
Pebulate	82669	.004	19	0	0	NA	NA	NA
Pendimethalin	82683	.022	19	0	0	NA	NA	NA
Phorate	82664	.011	19	0	0	NA	NA	NA
Picloram	49291	.04 .20	19	9	47	.01	.88	.07
Prometon	04037	.01	19	0	0	NA	NA	NA
Propyzamide	82676	.004 .005 .009	19	0	0	NA	NA	NA
Propachlor	04024	.025	19	0	0	NA	NA	NA
Propanil	82679	.011	19	0	0	NA	NA	NA
Propargite	82685	.02 .05 .08	18	0	0	NA	NA	NA
Silvex	39762	.03	19	0	0	NA	NA	NA
Simazine	04035	.005	19	0	0	NA	NA	NA
Tebuthiuron	82670	.02	19	0	0	NA	NA	NA
Terbacil	82665	.034 .040 .046 .051	19	0	0	NA	NA	NA
Terbufos	82675	.02	19	0	0	NA	NA	NA
Thiobencarb	82681	.010	19	0	0	NA	NA	NA
Triallate	82678	.006	19	0	0	NA	NA	NA
Trifluralin	82661	.009	19	0	0	NA	NA	NA

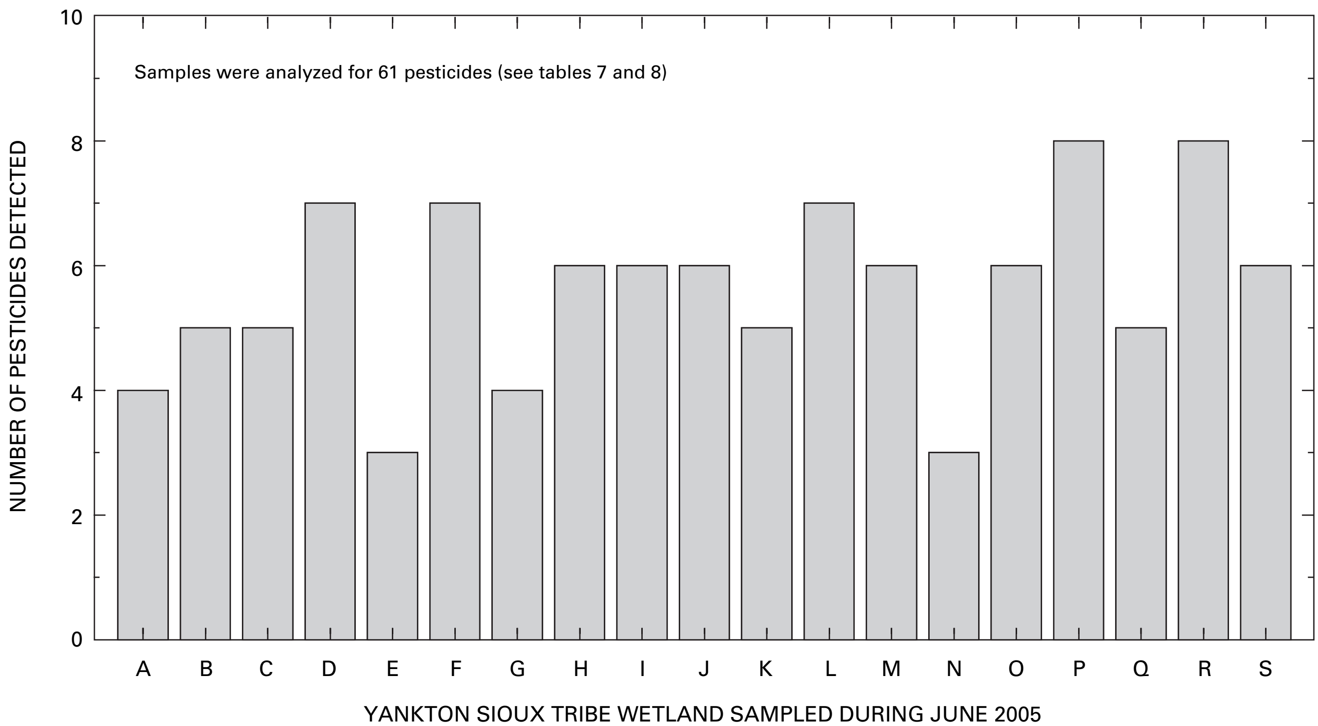

Figure 6. Number of pesticides detected in water samples from selected Yankton Sioux Tribe wetlands, June 2005.

Mercury

Whole-water samples from 10 selected Yankton Sioux Tribe wetlands were collected during June–July 2005. For each sample, the concentrations of both mercury and methylmercury dissolved in the water and in the suspended particulate in the water were determined (table 9). The concentration for whole-water total mercury was calculated by adding together the concentration of the dissolved mercury in the water and the concentration of the mercury in the suspended particulate. The concentration for whole-water methylmercury was calculated in the same way using the methylmercury concentration dissolved in the water and in the suspended particulate. The matrix spike recoveries for the results for the methylmercury concentrations dissolved in water indicate that concentrations may be 25 percent higher or lower than the concentration reported.

The whole-water total mercury and methylmercury concentrations in the water samples for each of the Yankton Sioux Tribe wetlands are shown in figure 7A. The whole-water total mercury concentrations for the samples ranged from 1.11 ng/L (wetland C) to 29.65 ng/L (wetland Q), with a median of 10.56 ng/L. The whole-water methylmercury concentrations for the samples ranged from 0.45 ng/L (wetland F) to 14.03 ng/L (wetland P), with a median of 2.28 ng/L.

Quality of Bottom Sediment in Wetlands

Bottom-sediment samples from 10 selected Yankton Sioux Tribe wetlands were collected during June–July 2005 in conjunction with collection of the water samples from the same wetlands. The bottom-sediment samples were analyzed for mercury, methylmercury, the ratio of dry weight to wet weight, and loss-on-ignition (table 9).

The total mercury concentrations for the bottom-sediment samples ranged from 21.3 ng/g (wetland K) to 74.6 ng/g (wetland N), with a median of 54.2 ng/g. The methylmercury concentrations ranged from <0.11 ng/g (wetland K) to 2.04 ng/g (wetland Q), with a median of detected concentrations of 0.78 ng/g. The total mercury and methylmercury concentrations in the bottom-sediment samples for each of the Yankton Sioux Tribe wetlands are shown in figure 7B.

The ratio of dry weight to wet weight is a indication of how much of the sediment was not liquid. The higher the number, the greater the fraction of the sediment that was composed of solids. The values ranged from 20.6 percent (wetland B) to 69.9 percent (wetland K), with a median of 37.8 percent (table 9).

Loss-on-ignition is an indication of the organic content of the sediment. The burning process leaves behind the nonorganic fraction of the sediment and the higher the number, the greater the fraction of the sediment that was organic. The values ranged from 6.6 percent (wetland K) to 29.4 percent (wetland B), with a median of 14.4 percent (table 9).

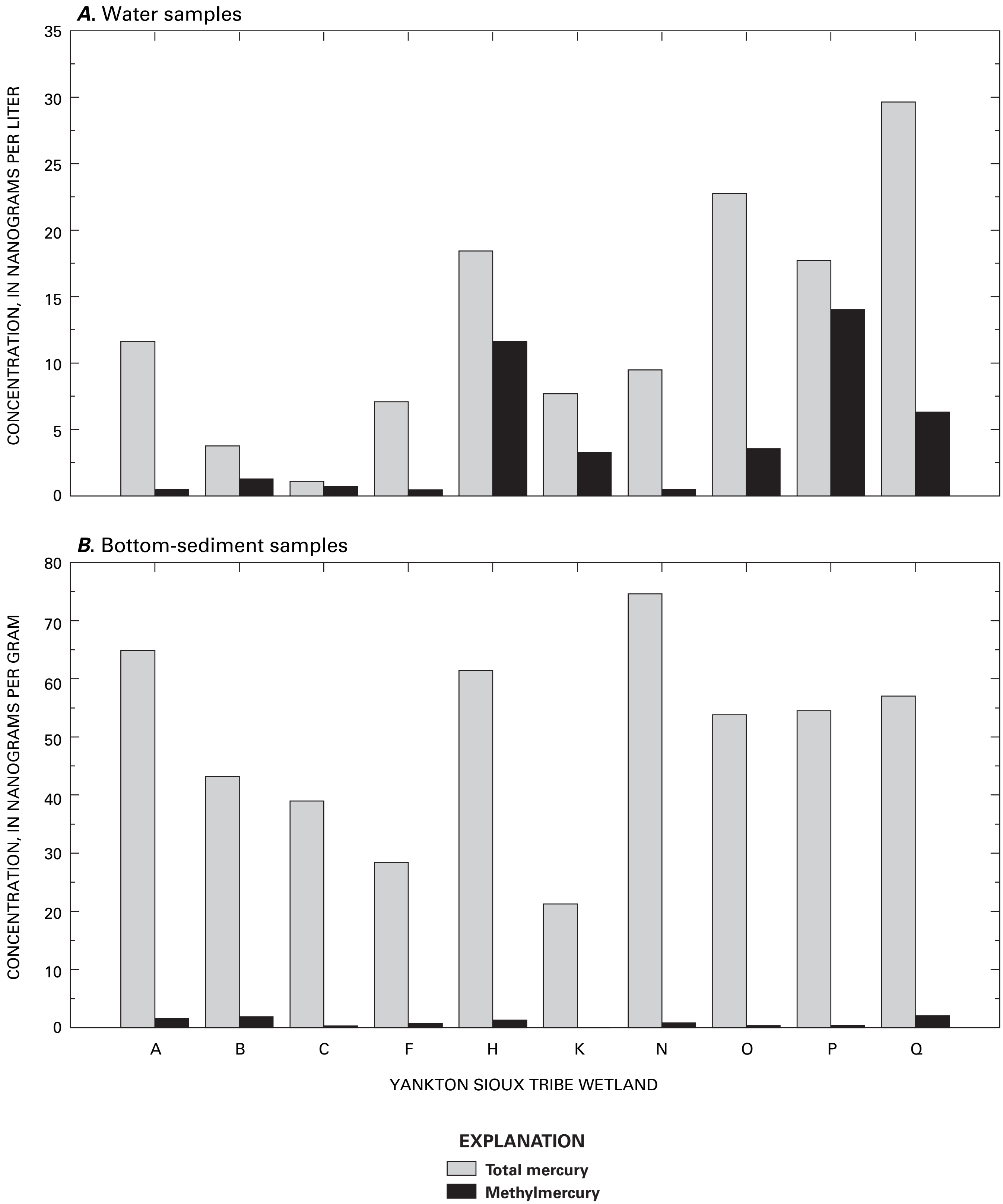

Figure 7. Total mercury and methylmercury concentations in (A) water samples and (B) bottom-sediment samples from selected Yankton Sioux Tribe wetlands, June–July 2005.

Synopsis of Atrazine and Mercury Results

The analytical results from this study show that some pesticides (table 7) and mercury species (table 9) were present in selected Yankton Sioux Tribe wetlands. Comparing these results to those from previous studies and to established water-quality standards may provide useful information relative to the quality of the water and sediments in Yankton Sioux Tribe wetlands. Rather than compare the results for all of the pesticides and all of the mercury species, this synopsis will focus on the results for atrazine and total mercury and methylmercury in water.

The U.S. Environmental Protection Agency has established drinking-water standards for some compounds that may cause adverse health effects from long-term exposure. These standards are known as Maximum Contaminant Levels (MCLs) (U.S. Environmental Protection Agency, 2002). Because MCLs apply only to drinking water from public-water supplies, the MCLs do not apply to any of the wetlands in the study area. However, these are national standards based on minimizing human-health risks and comparison to the respective MCLs provides for a common basis for different constituents.

Atrazine

Atrazine has been widely used in the study area (table 1). Atrazine was one of the 31 pesticides for which Battaglin and Goolsby (1994) estimated use in Charles Mix County in 1987. Of the 31 pesticides, atrazine was ranked fifth in the number of acres treated and sixth in pounds of active ingredient applied in Charles Mix County (table 1). Of the 17 pesticides for which Battaglin and Goolsby (1994) provided estimates and were analyzed for in selected Yankton Sioux Tribe wetlands, atrazine ranked sixth in pounds of active ingredient applied.

Atrazine has been detected more frequently than any other pesticide in the surface waters of the study area. The atrazine concentrations for the Yankton Sioux wetlands, Lake Andes/Owens Bay, and Lake Francis Case/Missouri River are shown in figure 8. The order of presentation is based on the drainage basin size, from the smallest drainage basins of the individual Yankton Sioux wetlands, of which many are less than a square mile, to the largest drainage basin of the Missouri River, which includes hundreds of thousands of square miles upstream from Charles Mix County.

Atrazine was detected in water samples from all 19 of the wetlands from which samples were collected for this study. The samples from June 2005 had minimum, maximum, and median dissolved concentrations of 0.056, 0.567, and 0.151 μg/L, respectively (table 8).

Atrazine was detected in almost all of the samples from Lake Andes and Owens Bay (Sando and Neitzert, 2003; U.S. Geological Survey, 2002, 2003). Of the 85 water samples collected during 1990–2000, total atrazine was detected in 62 of the samples with a minimum concentration of 0.1 μg/L, a maximum concentration of 2.0 μg/L, and a median concentration of 0.3 μg/L. Of the 15 water samples collected during 2001–2002, dissolved atrazine was detected in all 15 samples with a minimum concentration of 0.011 μg/L, a maximum concentration of 0.286 μg/L, and a median concentration of 0.100 μg/L.

Atrazine has been detected in all of the samples collected from Lake Francis Case, the Missouri River at Fort Randall Dam, and the Missouri River below Choteau Creek (U.S. Geological Survey, 2003–2006) (table 2). Of the 24 water samples collected during 2002–2005 from the Missouri River, dissolved atrazine was detected in all 24 samples with a minimum concentration of 0.012 μg/L, a maximum concentration of 0.040 μg/L, and a median concentration of 0.021 μg/L.

The samples for all three studies were collected in April, May, or June, when it was considered to be most likely to detect atrazine and at its highest concentrations. Although the detection frequency has been high, none of the atrazine concentrations have been greater than 3 μg/L (fig. 8), which is the MCL for atrazine for drinking water (U.S. Environmental Protection Agency, 2002). Field and laboratory studies have shown that atrazine may be associated with endocrine-disruption in aquatic organisms (Hayes and others, 2003; Spano and others, 2004). Atrazine exposure has been reported to result in reproductive abnormalities in frogs at concentrations as small as 0.1 μg/L (Hayes and others, 2003), but reported effect levels for fish are substantially larger (Sando and others, 2006). The atrazine concentrations found in water samples from selected Yankton Sioux Tribe wetlands (table 6) are smaller than those generally suspected of affecting the development of fish, but could have some effect on the reproduction of some aquatic organisms. Further research is needed to fully assess the potential for endocrine disruption of aquatic organisms.

Mercury

The occurrence of mercury and methylmercury in natural wetlands is affected by many factors. An investigation of those factors is beyond the scope of this report, but a more extensive study of wetlands in the same physiographic region (Missouri River Coteau) in North Dakota found pH, specific conductance, sulfate concentrations, and other properties to be related to mercury and methylmercury concentrations (Sando, 2004).

The 10 samples collected for this study show that mercury and methylmercury occur at a broad range of concentrations in the water and bottom sediment of selected Yankton Sioux Tribe wetlands. The results show that higher total mercury concentrations in the water samples are not necessarily associated with higher methylmercury concentrations in the water or higher total mercury concentrations in the bottom sediment (table 9, fig. 7).

Table 9. Mercury concentrations in water and bottom-sediment samples from selected Yankton Sioux Tribe wetlands, June–July 2005.

[ng/L, nanograms per liter; ng/g, nanograms per gram; <, less than the method detection limit; NA, not applicable. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

				Water						Bottom sediment			
Site (fig. 2)	Station number	Date	Time	Whole-water total mercury, in ng/L	Dissolved total mercury, in ng/L (50287)	Suspended particulate total mercury, in ng/L (62976)	Whole-water methyl-mercury, in ng/L	Dissolved methyl-mercury, in ng/L (50285)	Suspended particulate methyl-mercury, in ng/L (62977)	Total mercury, in ng/g (62978)	Methyl mercury, in ng/g (62979)	Dry weight to wet weight, in percent (64177)	Loss-on-ignition, in percent (64178)
A	431907098321000	06-14-2005	0955	11.63	6.87	4.76	0.51	[3]0.20	0.31	64.9	1.59	36.5	22.3
B	431853098322600	06-14-2005	0830	3.78	2.45	1.33	1.28	[3].92	.36	43.2	1.89	20.6	29.4
C	431759098334000	07-13-2005	1200	1.11	1.11	<.07	.73	[3].40	.33	39.0	.27	37.6	10.8
F	430735098193000	07-11-2005	1315	7.14	.28	6.86	.45	[3].06	.39	28.4	.72	51.7	8.0
F[1]	430735098193000	07-11-2005	1320	8.63	.31	8.32	.32	<.04	.32	29.4	.73	52.1	7.6
H	430500098064000	07-12-2005	0925	18.44	15.80	2.64	11.63	[3]10.40	1.23	61.4	1.30	32.3	28.9
K	430311098253000	07-12-2005	1145	7.69	6.13	1.56	3.28	[3]2.36	.92	21.3	<.11	69.9	6.6
N	430226098281400	07-12-2005	1330	9.49	1.10	8.39	.51	[3].25	.26	74.6	.83	37.3	9.9
O	430202098230300	07-13-2005	0950	22.77	4.93	17.84	3.57	[3]1.44	2.13	53.8	.36	60.7	11.7
P	430125098120600	07-12-2005	1035	17.75	9.72	8.03	14.03	[3]7.40	6.63	54.5	.42	38.1	17.0
Q[2]	425941098173400	07-11-2005	1125	.54	.06	.48	<.04	[3]<.04	<.01	NA	NA	NA	NA
Q	425941098173400	07-11-2005	1130	29.65	4.19	25.46	6.31	[3]1.42	4.89	57.0	2.04	44.0	18.0

[1] Replicate sample

[2] Blank sample

[3] Matrix spike recoveries indicate that concentrations may be greater than 25 percent higher or lower than the reported concentration.

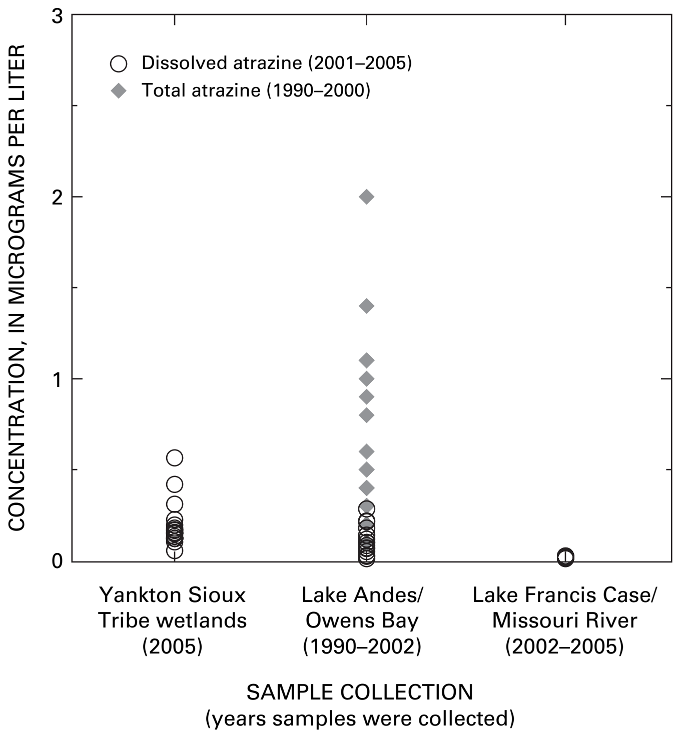

Figure 8. Atrazine concentrations in water samples from selected Yankton Sioux Tribe wetlands, Lake Andes/Owens Bay, and Lake Francis Case/Missouri River.

The drinking water MCL for total mercury in water is 2 µg/L (U.S. Environmental Protection Agency, 2002) or 2,000 ng/L. The concentrations found in this study are all much less than the MCL. The State of South Dakota has established water-quality standards for wetlands based on a variety of uses including fish and wildlife propagation. The chronic standard for total recoverable mercury is 0.012 µg/L (South Dakota Department of Environment and Natural Resources, 2004) or 12 ng/L. Four of the wetlands (wetlands H, O, P, and Q) had whole-water total mercury concentrations greater than this standard in July 2005 (table 9). Compliance with chronic criteria is based on a 30-day average (South Dakota Department of Environment and Natural Resources, 2004), which indicates the importance of knowing average mercury concentrations over longer periods of time. Additional study of Yankton Sioux Tribe wetlands may indicate that bioaccumulation of mercury may be affecting the aquatic species of the wetlands, which may result in human-health concerns if aquatic species are consumed.

The largest whole-water total mercury concentration in a study of the Red River of the North Basin in North Dakota, Minnesota, and Manitoba (Sando and others, 2003) was found in a wetland site from which samples were collected. For the summer sampling periods, the whole-water total mercury (7.02 ng/L) and whole-water methylmercury (3.53 ng/L) concentrations found in the wetland were larger than those detected in the lakes and rivers sampled for the study. Results from this study of Yankton Sioux Tribe wetlands indicate that maximum whole-water total mercury (29.65 ng/L) and whole-water methylmercury concentrations (14.03 ng/L) are larger than concentrations in the Red River of the North Basin.

The largest whole-water total mercury and whole-water methylmercury concentrations in a study of wetlands in the Lostwood National Wildlife Refuge along the Missouri River in North Dakota (Sando, 2004) were 17.2 and 9.56 ng/L, respectively (Steve Sando, USGS, written commun., 2005). Results from this study of Yankton Sioux Tribe wetlands indicate that the maximum whole-water total mercury (29.65 ng/L) and whole-water methylmercury concentration (14.03 ng/L) are somewhat larger than those in the Lostwood National Wildlife Refuge area.

The largest whole-water total mercury and whole-water methylmercury concentrations at Lee Dam in the Cheyenne River Indian Reservation in north-central South Dakota (U.S. Environmental Protection Agency, 2005) were 100 and 2.9 ng/L, respectively. Results from this study of Yankton Sioux Tribe wetlands indicate that the maximum whole-water total mercury concentration (29.65 ng/L) was smaller and the maximum whole-water methylmercury concentration (14.03 ng/L) was larger than concentrations at Lee Dam.

Summary

During June and July 2005, water and bottom-sediment samples were collected from selected Yankton Sioux Tribe wetlands within the historic Reservation area of eastern Charles Mix County as part of a reconnaissance-level assessment by the U.S. Geological Survey and Yankton Sioux Tribe. The water samples were analyzed for pesticides and mercury species. In addition, the water samples were analyzed for physical properties and chemical constituents that might help characterize the wetlands. The bottom-sediment samples were analyzed for mercury species.

During June 2005, water samples were collected from 19 wetlands and were analyzed for 61 widely used pesticide compounds. During June and July 2005, water and bottom-sediment samples were collected from 10 wetlands. Water samples from each of the wetlands were analyzed for major ions, organic carbon, and mercury species, and bottom-sediment samples were analyzed for mercury species.

Samples for major ions had dissolved calcium concentrations ranging from 27.4 to 506 mg/L; dissolved magnesium concentrations ranging from 7.92 to 491 mg/L; dissolved sodium concentrations ranging from 1.63 to 660 mg/L; and dissolved sulfate concentrations ranging from 3.13 to 3,610 mg/L. Concentrations for total organic carbon ranged from 25.1 to 210 mg/L, with a median of 41.2 mg/L. Concentrations for dissolved organic carbon ranged from 8.8 to 72 mg/L, with a median of 30 mg/L.

Many pesticides were not detected in any of the water samples and many others were detected only at low concentrations in a few of the samples. Thirteen of the pesticides were detected in water samples from at least one of the wetlands. Atrazine and de-ethyl atrazine were detected at each of the 19 wetlands. The minimum, maximum, and median dissolved atrazine concentrations were 0.056, 0.567, and 0.151 µg/L, respectively. Four pesticides (alachlor, carbaryl, chlorpyrifos, and dicamba) were detected in only one wetland each. The number of pesticides detected in any of the 19 wetlands ranged from 3 to 8, with a median of 6. In addition to the results for this study, recent previous studies have frequently found atrazine in Lake Andes and the Missouri River, but none of the atrazine concentrations have been greater than 3 µg/L, the USEPA's MCL for atrazine. The atrazine concentrations found in water samples from selected Yankton Sioux Tribe wetlands are smaller than those generally suspected of affecting the development of fish, but could have some effect on the reproduction of some aquatic organisms.

For the whole-water samples, the total mercury concentrations ranged from 1.11 to 29.65 ng/L, with a median of 10.56 ng/L. The methylmercury concentrations ranged from 0.45 to 14.03 ng/L, with a median of 2.28 ng/L. For the bottom-sediment samples, the total mercury concentration ranged from 21.3 to 74.6 ng/g, with a median of 54.2 ng/g. The methylmercury concentrations ranged from <0.11 to 2.04 ng/g, with a median of 0.78 ng/g. The total mercury concentrations in the water samples were all much less than 2 µg/L (2,000 ng/L), the U.S. Environmental Protection Agency's Maximum Contaminant Level for mercury, but four of the wetlands had concentrations greater than 0.012 µg/L (12 ng/L), the State of South Dakota's chronic standard for surface waters, including wetlands. Maximum methylmercury concentrations for this study are greater than reported concentrations for wetlands in North Dakota and concentrations reported for the Cheyenne River Indian Reservation in South Dakota.

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Supplemental Information

Section A. Chlorophyll *a* and Pheophytin *a* in Water Samples from Yankton Sioux Tribe Wetlands A and B

Supplemental Information section A provides information about water-quality samples collected on June 14, 2005, at Yankton Sioux Tribe wetlands A and B and analyzed for chlorophyll *a* and pheophytin *a*. These were the only two wetlands in this study from which samples were analyzed for chlorophyll *a* and pheophytin *a,* and the samples were collected to obtain general information for algae growth for some wetlands that could be used in comparison with concentrations of other water bodies in the area. The two wetlands are close together (fig. 2), in areas with similar land uses, and both have been assigned PEMC wetland inventory codes (table 3).

The chlorophyll *a* concentration was larger in wetland A (14.8 µg/L) than in wetland B (2.44 µg/L). For pheophytin *a*, the relation was reversed with a higher concentration in wetland B (15.3 µg/L) than in wetland A (12.5 µg/L). These results, presented in table A1, show that samples collected from these two wetlands with sampling intervals less than 2 hours apart have distinctly different values for these constituents.

Table A1. Chlorophyll *a* and pheophytin *a* concentrations in water samples from Yankton Sioux Tribe wetlands A and B, June 2005.

[µg/L, micrograms per liter. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Wetland (fig. 2)	Station number	Date	Time	Chlorophyll *a,* phytoplankton, in µg/L (70953)	Pheophytin *a,* phytoplankton, in µg/L (62360)
A	431907098321000	06-14-2005	0955	14.8	12.5
B	431853098322600	06-14-2005	0830	2.44	15.3

Section B. Nitrogen and Phosphorus in Water Samples from Yankton Sioux Tribe Wetlands A and B

Supplemental Information section B provides information about water-quality samples collected on June 14, 2005, at Yankton Sioux Tribe wetlands A and B and analyzed for nitrogen and phosphorus species. These were the only two wetlands in this study from which samples were analyzed for these constituents (table B1). The two wetlands are close together (fig. 2), in areas with similar land uses, and both have been assigned PEMC wetland inventory codes (table 3).

For four of the nitrogen species, concentrations in wetland A were less than those in wetland B (table B1). For dissolved nitrogen as ammonia, the concentration (0.337 mg/L) in wetland A was an order of magnitude less than the concentration (3.23 mg/L) in wetland B. For the fifth nitrogen species, dissolved nitrogen as nitrite plus nitrate, concentrations at both wetlands A and B were less than 0.060 mg/L (table B1).

For all three phosphorus species (dissolved phosphorus, dissolved phosphorus as orthophosphate, and total phosphorus), concentrations were greater in wetland A than in wetland B (table B1). More than twice as much total phosphorus was found in wetland A (2.19 mg/L) than in wetland B (1.05 mg/L).

Table B1. Nitrogen and phosphorus concentrations in water samples from Yankton Sioux Tribe wetlands A and B, June 2005.

[mg/L, milligrams per liter; <, less than laboratory reporting level. Number in parenthesis below constituent is U.S. Geological Survey National Water Information System parameter code.]

Wetland (fig. 2)	Station number	Date	Time	Dissolved nitrogen, as ammonia, in mg/L (00608)	Dissolved nitrogen, ammonia plus organic, in mg/L (00623)	Total nitrogen, ammonia plus organic, in mg/L (00625)	Dissolved nitrogen, as nitrite, in mg/L (00613)
A	431907098321000	06-14-2005	0955	0.337	3.6	7.5	0.008
B	431853098322600	06-14-2005	0830	3.23	7.7	8.0	.009

Wetland (fig. 2)	Station number	Date	Time	Dissolved nitrogen, as nitrite plus nitrate, in mg/L (00631)	Dissolved phosphorus, in mg/L (00666)	Dissolved phosphorus, as orthophosphate, in mg/L (00671)	Total phosphorus, in mg/L (00665)
A	431907098321000	06-14-2005	0955	<0.060	1.15	1.1	2.19
B	431853098322600	06-14-2005	0830	<.060	.96	1.0	1.05

Section C. U.S. Fish and Wildlife Service wetlands inventory codes and definitions

Supplemental Information section C provides information about U.S. Fish and Wildlife Service wetlands inventory codes and definitions for the selected Yankton Sioux Tribe wetlands at which water and bottom-sediment samples were collected during June–July 2005. The U.S. Fish and Wildlife Service wetlands inventory for Charles Mix County, South Dakota, was accessed on October 21, 2004, at *http://wetlandsfws.er.usgs.gov/*. The inventory is in the form of a geographic information system shapefile for individual U.S. Geological Survey quadrangles consisting of delineated wetlands and attributes of the wetlands. One of the attributes for each wetland is a code that indicates how the wetland has been classified in terms of various factors including geomorphology, water quality, vegetation, and the duration of the presence of standing water.

Of the 19 wetlands from which water-quality samples were collected, only wetland D (Goose Lake), did not have an associated wetland inventory code. The remaining 18 wetlands are all classified as palustrine. Ten of the wetlands have been assigned the PEMC code, four have been assigned the PEM/ABF code, and one each have been assigned the PABF, PEMCd, PEMFd, or PFOC codes (table C1).

The following attribute classification definitions listed were derived from Cowardin and others (1979). These are the "short" definitions provided by the U.S. Fish and Wildlife Service at *http://enterprise.nwi.fws.gov/atx/atx.html*.

[P] Palustrine - The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 part per thousand. Wetlands lacking such vegetation also are included if they exhibit all of the following characteristics:

1. are less than 8 hectares (20 acres);
2. do not have an active wave-formed or bedrock shoreline feature;
3. have at low water a depth less than 2 m (6.6 ft) in the deepest part of the basin; and
4. have a salinity due to ocean-derived salts of less than 0.5 part per thousand.

[AB] Aquatic Bed - Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Aquatic beds generally occur in water less than 2 m (6.6 ft) deep and are placed in the Littoral Subsystem (if in Lacustrine System).

[EM] Emergent - Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.

[F] Semi-permanently Flooded - Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land's surface.

[FO] Forested - Characterized by woody vegetation that is 6 m tall or taller.

[C] Seasonally Flooded - Surface water is present for extended periods especially early in the growing season, but

Table C1. U.S. Fish and Wildlife Service wetlands inventory codes for selected Yankton Sioux Tribe wetlands at which water-quality samples were collected during June–July 2005.

Code (table 3)	Definition	Sampling sites[1] (fig. 2)	Total number of sites
PABF	Palustrine, Aquatic Bed, Semi-permanently Flooded	C	1
PEM/ABF	Palustrine, EMergent, Aquatic Bed, Semi-permanently Flooded	J, P, R, S	4
PEMC	Palustrine, EMergent, Seasonally Flooded	A, B, E, F, G, K, L, M, O, Q	10
PEMCd	Palustrine, EMergent, Seasonally Flooded, partially drained/ditched	I	1
PEMFd	Palustrine, EMergent, Semi-permanently Flooded, partially drained/ditched	H	1
PFOC	Palustrine, FOrested, Seasonally Flooded	N	1

[1]There was no wetland inventory code for Goose Lake (sampling site D).

is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

[d] Partly Drained/Ditched - The water level has been artificially lowered, but the area is still classified as wetland because soil moisture is sufficient to support hydrophytes. Drained areas are not considered wetlands if they can no longer support hydrophytes. This modifier also is used to indicate extensive ditch networks in wetlands where, due to the extreme number and narrow width of the ditches, individual delineation is impossible. Individual ditches shall be broken out as linears (with Excavated modifier) when they approximate the pen line width on the photography and if the area is not overly complex.

For more information concerning the research in this report, contact :
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