IOWA'S WATER
Ambient Monitoring Program

Results of Wetland Monitoring 2005-2007

Wetland monitoring at a prairie pothole at Union Hills Waterfowl Production Area, Cerro Gordo County.

Introduction

During 2007, the Iowa DNR's Watershed Monitoring and Assessment Section completed a three-year wetland monitoring project. This project, funded by a wetland grant from the U.S. Environmental Protection Agency (EPA), assessed wetland water quality at randomly selected sites throughout north-central Iowa's "Prairie Pothole" region (Figure 1). By randomly selecting a large number of wetlands to sample from both public and private lands, an estimate of the water quality of wetlands in the region can be produced. Wetland monitoring is a new endeavor for the Iowa Department of Natural Resources (IDNR). This project was the first attempt in Iowa to quantify wetland water quality at such a large scale. Methods for sampling and assessing Iowa's wetlands did not previously exist, but were developed during the course of the project. Wetland monitoring is an important part of assessing the state's water quality in accordance with the Clean Water Act and to assess performance of restoration and protection activities (for a review of why wetlands are monitored see www.igsb.uiowa.edu/gsbpubs/pdf/WFS-2006-07.pdf). Further development of methods will allow for detailed assessments of plant and animal communities within wetlands. It is necessary to conduct biological assessments in conjunction with water quality monitoring to understand and document the leading stressors to aquatic life. Development of biological methods has begun, but at this time these methods are incomplete and need further field testing.

Results

Water and sediment were sampled once from each wetland during June, July, and August. Also during 2006 and 2007, some sites from previous years were re-sampled to look at variation among years.

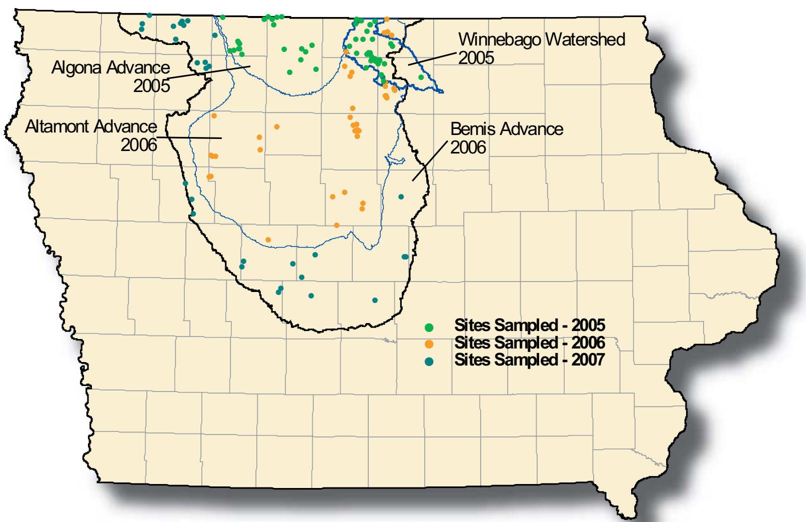

Figure 1. *Location of wetlands sampled from 2005-2007 (60 sites in 2005, 71 in 2006, and 58 in 2007). Advances represent various extents of Wisconsin-age glacial ice.*

Table 1. *The number of pesticides or pesticide degradates detected per site from 2005-2007.*

Number of Different Pesticides At Each Site	Number of Sites		
	2005	2006	2007
0	2	0	0
1	0	2	1
2	2	1	0
3	0	4	3
4	8	3	2
5	3	2	9
6	15	11	5
7	8	13	11
8	7	16	8
9	7	13	7
10	5	2	9
11	0	1	1
12	2	1	1
13	0	1	1
14	1	0	0
15	0	1	0
Yearly Average:	7	7	7

Analysis of samples included tests for common insecticides, herbicides, metals, PCBs, and measures of nitrogen, phosphorus, suspended solids, dissolved solids, and some common physical/chemical parameters, such as dissolved oxygen, turbidity, and temperature. A detailed summary of these data is beyond the scope of this fact sheet, but a few things are apparent from preliminary analysis. Most of the sites in this study contained detectable amounts of one or more herbicides in water samples. In contrast, no insecticides or PCBs were detected in the water from any site during this study. Two sites in 2005 did not contain any detectable amounts of herbicides. However, all sites in 2006 and 2007 had detectable amounts of at least one herbicide and in most cases multiple herbicides were detected. A summary of the number of contaminants detected in the water at each site during this study is presented in Table 1. Of the herbicides detected during this study atrazine (and its degradate desethyl atrazine), metolachlor (and its degradates), acetochlor's degradates, alachlor's degradates, and flumetsulam were detected more than 45 times each throughout the study. Table 2 presents the number of times each herbicide was detected in water samples during this study.

By utilizing a randomized sampling method, the data collected can be used to extrapolate the sampled resource as a whole. This can be done by plotting the cumulative distribution function (CDF) for an analyte. These plots can be used to answer questions such as: "How many wetlands contain greater than 0.1 μg/L of atrazine?" or "How many wetlands between one and five acres would meet the aquatic life criteria for copper?" See the water monitoring fact sheet at www.igsb.uiowa.edu/gsbpubs/pdf/WFS-2007-05.pdf for a detailed description of randomized assessments and CDF plots.

In contrast to water samples, few analytes were detected in sediments. The herbicides atrazine and its degradates, metolachlor, alachlor, cyanazine, and bromacil were detected. Also, a few persistent chlorinated organic pesticides and/or their degradates (i.e. dieldrin, heptachlor epoxide, DDD, DDE, and aldrin) were detected. In general, most sites did not contain detectable amounts of herbicides, insecticides, or PCBs were not detected in any of the sediments.

Table 2. *Summary of the pesticides detected from 2005-2007.*

2005 n=60 sites			
Compound	# of Detects	Mean Conc. (µg/L)	Max Conc. (µg/L)
Atrazine	58	0.311	2.8
Acetochlor OXA	54	0.23	1.8
Desethyl Atrazine	49	0.092	0.2
Acetochlor ESA	49	0.363	1.8
Metolachlor ESA	46	0.06	0.5
Alachlor ESA	36	0.118	0.74
Metolachlor OXA	34	0.149	1.5
Alachlor OXA	16	0.054	0.5
Flumetsulam	12	0.01	0.025
Imazethapyr	9	0.01	0.047
Heptachlor Epoxide	6	0.15	0.2
Nicosulfuron	5	0.135	0.57
Metolachlor	5	0.029	0.17
Desisopropyl Atrazine	5	0.081	0.16
Acetochlor	4	0.08	0.12
Dimethenamid ESA	4	0.207	0.5
Dimethenamid OXA	3	0.096	0.13
Methoxychlor	2	0.1	0.1
Metsulfuron Methyl	2	0.007	0.0075
Rimsulfuron	2	0.0925	0.18
Trifluralin	1	NA	0.2
Simazine	1	NA	4.2
Primisulfuron Methyl	1	NA	0.01
Picloram	1	NA	1
Endrin	1	NA	0.1
Diemethenamid	1	NA	0.081
Chlorsulfuron	1	NA	0.01
Bentazon	1	NA	7
2,4-D	1	NA	5

2006 n=71 sites			
Compound	# of Detects	Mean Conc. (µg/L)	Max Conc. (µg/L)
Acetochlor OXA	69	0.185	0.6
Acetochlor ESA	67	0.242	1.1
Atrazine	62	0.077	0.13
Alachlor ESA	49	0.103	0.59
Desethyl Atrazine	42	0.052	0.079
Alachlor OXA	34	0.091	0.23
Flumetsulam	19	0.015	0.045
Metolachlor OXA	15	0.15	1.4
Metolachlor ESA	11	0.74	5.4
Dimethenamid ESA	10	0.154	0.28
Imazethapyr	9	0.097	0.026
Imazapyr	8	0.099	0.016
Metolachlor	8	0.036	0.077
Nicosulfuron	5	0.0065	0.0084
Desisopropyl Atrazine	4	0.054	0.058
Acetochlor	1	NA	0.028
Chlorsulfuron	1	NA	0.018
Imazaquin	1	NA	0.0055
Metsulfuron Methyl	1	NA	0.0079
Picloram	1	NA	2.4
Sulfometuron Methyl	1	NA	0.044

NA = not applicable

2007 n=58 sites			
Compound	# of Detects	Mean Conc. (µg/L)	Max Conc. (µg/L)
Acetochlor OXA	54	0.3383	2.700
Atrazine	51	0.3794	7.000
Acetochlor ESA	50	0.3219	1.400
Metolachlor ESA	49	0.6568	8.800
Metolachlor OXA	44	0.1801	0.750
Alachlor ESA	36	0.0889	0.370
Desethyl Atrazine	36	0.1081	0.600
Metolachlor	32	0.1049	0.390
Alachlor OXA	23	0.0769	0.300
Flumetsulam	15	0.0140	0.028
Imazethapyr	12	0.0090	0.018
Acetochlor	6	0.0680	0.092
Dimethenamid ESA	6	0.0605	0.100
Dimethenamid OXA	6	0.0577	0.073
Desisopropyl Atrazine	4	0.0570	0.110
Dimethenamid	4	0.1361	0.400
Nicosulfuron	2	0.0435	0.068
Alachlor	1	NA	0.063
Bentazon	1	NA	2.000
Imazapyr	1	NA	0.008

What do these results mean?

With the help of the wetland grant provided through the EPA, the results of this study have provided an initial frame of reference for the water quality of Iowa's prairie pothole wetlands. These results are beneficial in providing information that did not previously exist about wetlands in northern Iowa. Examples include:

- The type and amounts of pesticides and other contaminants present (or absent) in northern Iowa wetlands.
- Herbicides are common in northern Iowa wetlands; insecticides are not.
- Analytical tools (such as CDFs produced from monitoring data) can help predict the probability of pesticides occurring in northern Iowa wetlands.
- Contaminants occur more readily in wetland water samples and infrequently in wetland sediment samples.

This information is useful in documenting what is, or is not, present in our wetlands. Understanding the range of contaminant concentrations within wetlands will be important for decisions related to wetland protection and management. It will also be important to further understand how these stressors affect the functions and condition of wetlands. At this time, it is unclear how much pesticides, particularly herbicides, may be affecting aquatic life in northern Iowa's wetlands. Even though most pesticides were detected in relatively small concentrations, it will be critical to understand whether these amounts and/or mixtures of pesticides are harming aquatic life. These pesticide data are currently being analyzed to find possible correlations among such variables as surrounding land

Understanding wetland stressors is the first step toward protecting aquatic life within wetland areas. White water lily shown above.

use patterns, geographical patterns, and the biological data that have been collected. Wetland monitoring data from 2005-2007 will continue to be analyzed to understand how the presence of herbicides correlates with aquatic life and water quality.

Future Study

These data illustrate the need for further, more detailed, wetland biological assessments to demonstrate the effects (if any) of these contaminants on wetland communities. More information on the effects of sedimentation, changes in wetland flora, and other common stressors are also needed. In the future, additional projects are planned to monitor wetlands throughout Iowa. Such projects will likely incorporate sampling of other wetland types such as riverine wetlands and fens. More work is planned to develop biological assessment methods for plants, invertebrates, and fish. Furthermore, such assessment methods may be useful for answering questions about wetlands in regard to watershed restoration and provide information about wetland restorations, protection, and management activities.

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Iowa Watershed Monitoring and Assessment Program Web Site – wqm.igsb.uiowa.edu

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