OCCURRENCE OF HERBICIDE DEGRADATION COMPOUNDS IN STREAMS AND GROUND WATER IN SOUTHERN GEORGIA, 2002

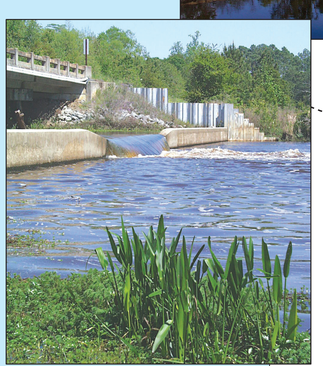
INTRODUCTION

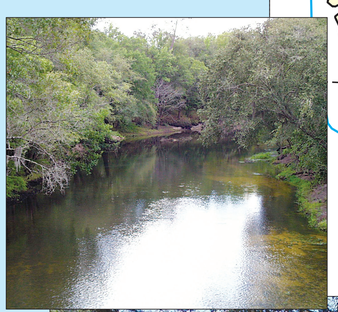
Ground-water and stream samples were collected to characterize water quality in agricultural areas in southern Georgia as part of the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) program. The primary objectives of the NAWQA program are to:

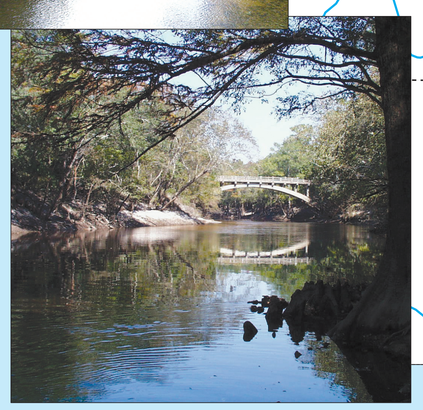
(1) describe the condition of the Nation's stream and ground-water resources,
(2) examine long-term trends in water-quality conditions, and
(3) evaluate human and natural processes that control water quality (Gilliom and others, 1995).

Sampling at a well adjacent to an agricultural field

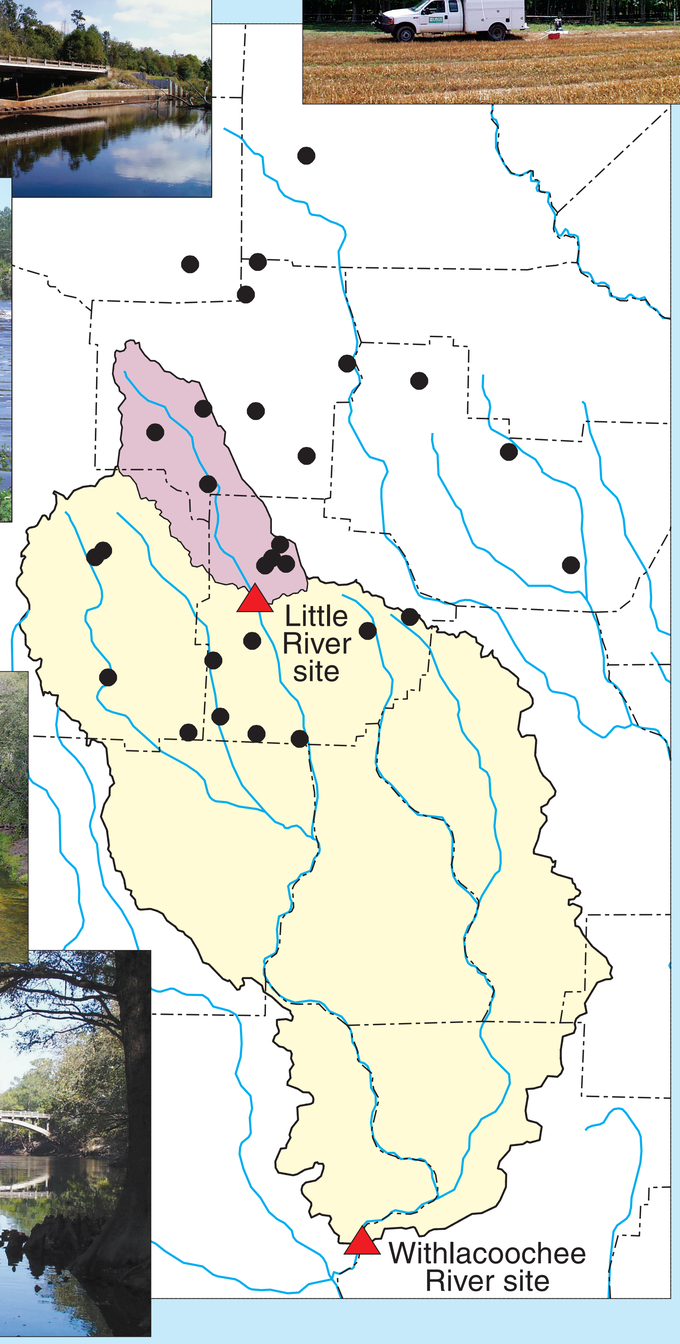
The Little River sampling site near Tifton, Georgia







The Withlacoochee River sampling site near Quitman, Georgia



EXPLANATION

- Withlacoochee River basin
- Little River basin
- Well sampling site
- Stream sampling site

0 10 20 MILES

0 10 20 KILOMETERS

Use of common reporting level

Reporting levels for the herbicides and herbicide degradation compounds ranged from 0.006 to 0.05 micrograms per liter (µg/L). Because differences in reporting levels influence the interpretation of detection frequencies, a common detection threshold of 0.05 µg/L was used for the frequency of detection for all herbicides and herbicide degradation compounds.

IMPORTANCE OF ANALYZING HERBICIDE DEGRADATION COMPOUNDS

The herbicide degradation compounds of metolachlor, alachlor, and atrazine, have been detected more frequently and at higher concentrations than their parent compounds in streams and ground water in Iowa (Kalkoff and others, 1998; Kolpin and others, 1997) and New York (Eckhardt and others, 2001; Phillips and others, 2000).

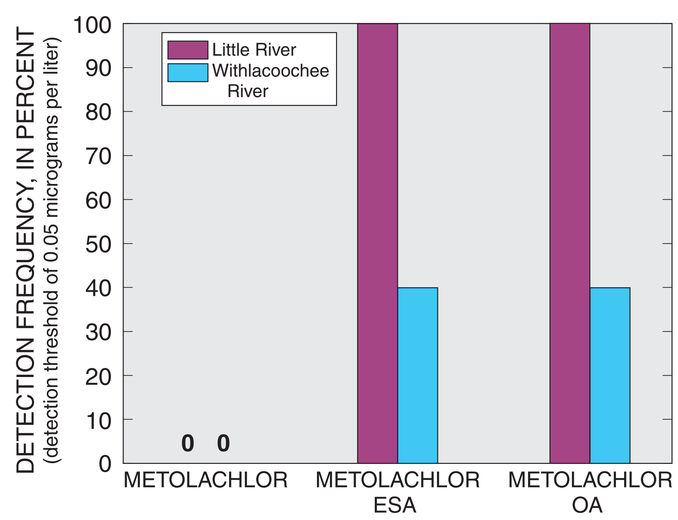
These findings highlight the importance of analyzing degradation compounds of herbicides to assess the occurrence and environmental fate of herbicides in hydrologic systems.

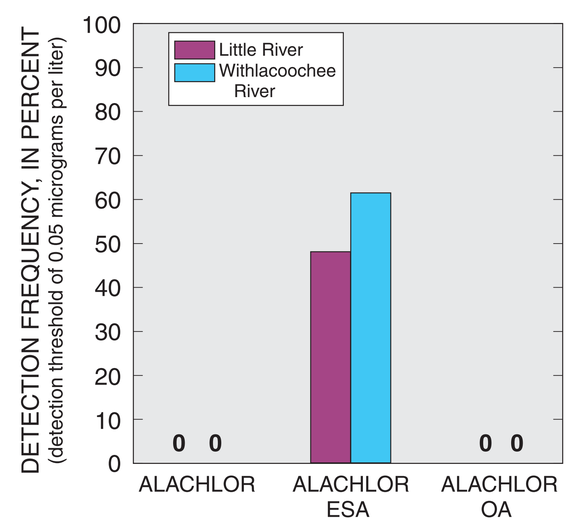
For these reasons, degradation compounds of selected herbicides were analyzed in ground water and streams in selected agricultural areas across the Nation for the NAWQA program in 2002, including southern Georgia.

HERBICIDE DEGRADATION COMPOUNDS IN STREAMS

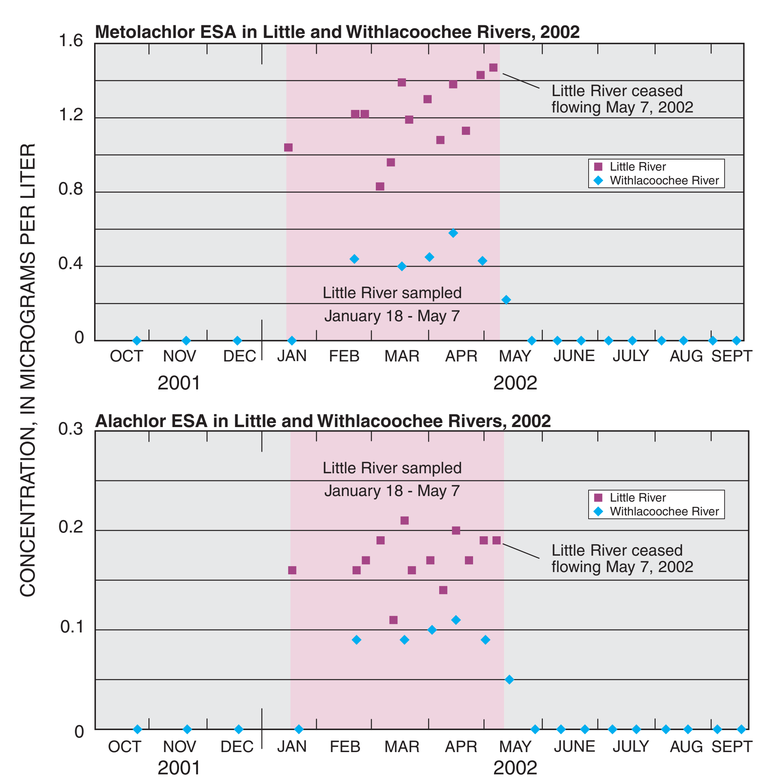
If degradation compounds were not analyzed, the fate of metolachlor and alachlor would be unknown.

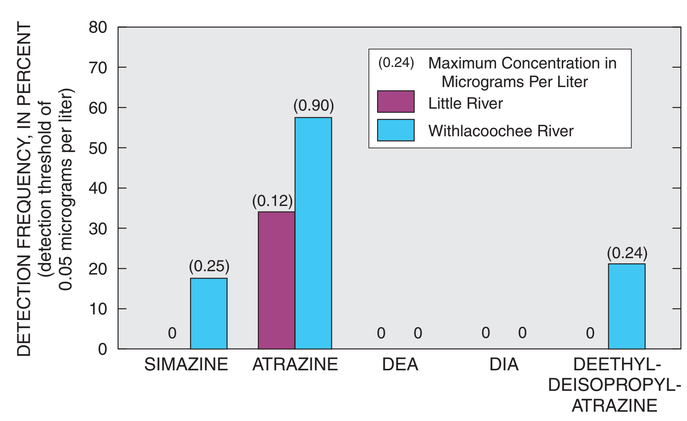
- Metolachlor and alachlor were not detected in stream samples but their degradation compounds were detected in 40 to 100 percent of the samples.





- Metolachlor ESA and alachlor ESA were only detected in the Withlacoochee River from February through May 2002 (Little River ceased to flow in May 2002).
- Concentrations of metolachlor ESA and alachlor ESA were higher in the Little River than in the Withlacoochee River.





- Atrazine and simazine were detected in in 17 and 58 percent of Withlacoochee River samples, respectively.
- Atrazine was detected in 33 percent of Little River samples–simazine was not detected.
- Deethyldeisopropylatrazine was the only atrazine or simazine degradation compound detected.

By John R. Pittman and Marian P. Berndt
U.S. Geological Survey, Tallahassee, Florida

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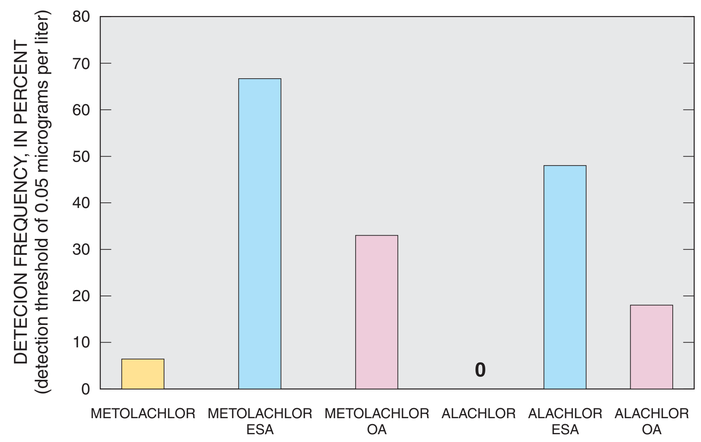
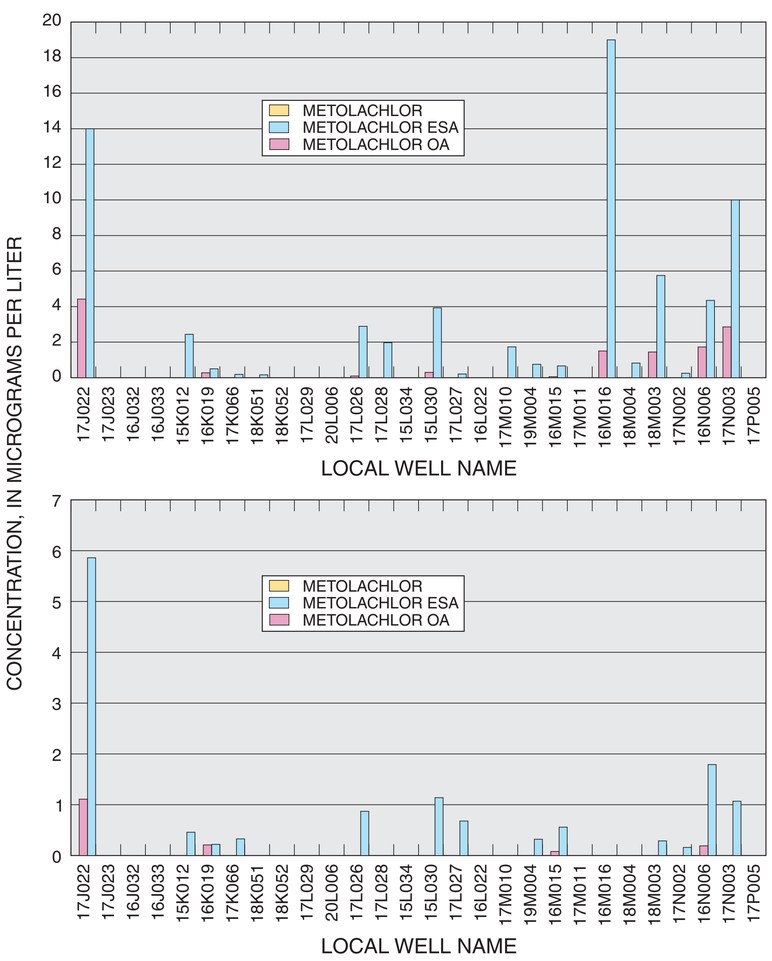
HERBICIDE DEGRADATION COMPOUNDS IN GROUND WATER

- Metolachlor was detected in 7 percent of ground-water samples and its degradation compounds, metolachlor ESA and metolachlor OA, were detected in 67 and 33 percent of the samples, respectively.
- Alachlor was not detected in ground-water samples but alachlor ESA and alachlor OA were detected in 48 and 18 percent of samples, respectively.





- Maximum concentrations of metolachlor ESA, alachlor ESA, and metolachlor OA are much higher in ground water than in stream water.
  - — the maximum concentration of metolachlor ESA in ground water was 19 µg/L compared to a maximum of 1.47 µg/L in stream water
  - — the maximum concentration of metolachlor OA was 4.42 µg/L in ground water compared to 0.28 µg/L in stream water
- The maximum concentration of metolachlor ESA in ground water was 19 µg/L, two orders of magnitude greater than the maximum concentration of its parent compound, metolachlor (0.13 µg/L).

Analytical methods

- Water samples were collected and processed according to USGS methods and were analyzed at the USGS National Water Quality Laboratory in Denver, Colorado, for over 180 pesticides and degradation compounds, including:
  - alachlor
  - metolachlor
  - atrazine
  - deethylatrazine (DEA)
  - deethyldeisopropylatrazine
  - deisopropylatrazine (DIA)
  - simazine
- Samples were also analyzed by the USGS Organic Geochemistry Research Group in Lawrence, Kansas, for:
  - acetochlor ethane sulfonic acid (ESA)
  - acetochlor oxanilic acid (OA)
  - alachlor ESA
  - alachlor OA
  - dimethenamid ESA
  - dimethenamid OA
  - flufenacet ESA
  - flufenacet OA
  - metolachlor ESA
  - metolachlor OA

  (Dimethenamid ESA and OA and flufenacet ESA and OA were not detected in samples in this study.)

Comparison to other studies

- The results of this study are similar to those found in Iowa (Kalkhoff and others, 1998), but differ in that the maximum concentrations of metolachlor ESA in ground-water samples are an order of magnitude higher than concentrations in stream samples.
- Differences between these study results and the results from the Iowa study could be related to differences in the types of wells sampled (low-capacity monitoring wells were sampled in this study compared to a combination of monitoring wells and municipal supply wells sampled in Iowa (Stephen J. Kalkhoff, U.S. Geological Survey, oral commun., 2003), and to the lower percentage of stream basin areas in agricultural land use. In this study, the Little River and the Withlacoochee River basins are approximately 67 and 56 percent agricultural land use, respectively, (Hatzell, 1996), whereas agricultural land use in the Iowa basins ranged from 87 to 96 percent (Becher and others, 2001).

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