

# INDICATOR-BACTERIA CONCENTRATIONS IN STREAMS OF THE CHATTAHOOCHEE RIVER NATIONAL RECREATION AREA, MARCH 1999–APRIL 2000

By M. Brian Gregory<sup>1/</sup> and Elizabeth A. Frick<sup>2/</sup>

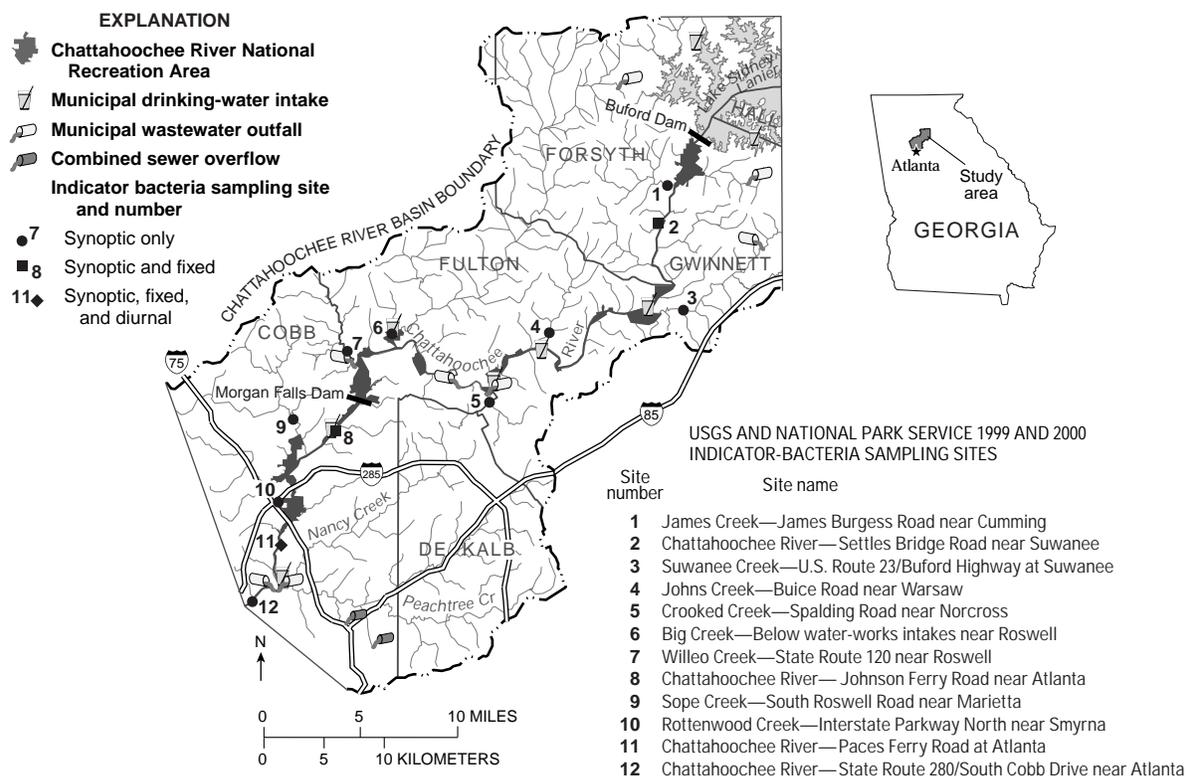
**AUTHORS:** <sup>1/</sup>Ecologist, <sup>2/</sup>Hydrologist, U.S. Geological Survey, 3039 Amwiler Road, Suite 130, Peachtree Business Center, Atlanta, GA 30360-2824

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## INTRODUCTION

In 1999, the U.S. Geological Survey (USGS) in cooperation with the National Park Service, began a two-year study designed to evaluate microbial contamination in streams in and near the Chattahoochee River National Recreation Area (CRNRA). The CRNRA is comprised of 14 park units and the 48-mile reach of the Chattahoochee River downstream from Buford Dam to Peachtree Creek (fig. 1). The Chattahoochee River is one of Georgia's most utilized water resources—supplying drinking water to a large percentage of people in Metropolitan Atlanta and serving as a receiving waterbody for treated wastewater

as well as untreated urban runoff. The CRNRA is a significant recreational resource in Metropolitan Atlanta, accounting for about 75 percent of all public green space in a 10-county area (Kunkle and Vana-Miller, 2000). The CRNRA attracted about 2.9 million visitors in 1999, 30 percent of whom participated in water-based activities (William J. Carroll, National Park Service, oral commun., 2000). Microbial contamination is an issue in the CRNRA due to the high numbers of people using the Chattahoochee River as a recreational resource and the potential sources of contamination such as nonpoint runoff and treated and untreated wastewater effluent.



**Figure 1. Location of study area, Chattahoochee River National Recreation Area, and indicator-bacteria sampling sites in the study area.**

The presence of indicator bacteria does not necessarily prove that pathogens are in the environment; however, the presence of indicator bacteria does show that contamination by fecal material has occurred. Measuring concentrations of indicator bacteria is more cost effective than testing for specific pathogens and provides information relevant to health risks associated with water-contact activities. Fecal-coliform bacteria have been widely used by State and Federal agencies as the preferred indicator bacteria. Georgia Environmental Protection Division's (GaEPD) microbial water-quality standards are based on the geometric-mean concentration of fecal-coliform bacteria calculated from at least 4 samples collected within a 30-day period (Georgia Environmental Protection Division, 2000; table 1). GaEPD geometric mean standard from May to October is 200 colonies per 100 milliliters (col/100 mL). In 1986, the U.S. Environmental Protection Agency (USEPA) recommended that states adopt *Escherichia coli* (*E. coli*) and *enterococci* standards for use in recreational waters (U.S. Environmental Protection Agency, 1986a) based on research showing direct relations between these bacteria and swimming-associated gastroenteritis (U.S. Environmental Protection Agency, 1986b).

The broad objectives of this study were to investigate the existence, severity, and extent of microbial contamination in the Chattahoochee River and eight major tributaries within the CRNRA (fig. 1). This was accomplished by (1) summarizing existing recent fecal-

coliform data (Gregory and Frick, 2000) (2) conducting routine monitoring of three indicator-bacteria at three sites on the Chattahoochee River from March 1999 to April 2000 (3) conducting synoptic surveys at four mainstem and eight tributary sites during low-flow and storm-flow conditions and (4) conducting diurnal sampling at one mainstem site. This paper briefly summarizes fecal-coliform bacteria, *E. coli*, and *enterococci* concentrations measured as part of this study on the Chattahoochee River and tributary streams from March 1999 to April 2000.

### Study design and methods

Three Chattahoochee River sites were sampled every 5 days from March–October 1999 and every eight days from October 1999–April 2000. Synoptic sampling of four Chattahoochee River sites and eight tributary stream sites was conducted on four dates during low-flow and storm-flow conditions. Diurnal samples were collected every 2 hours for 26-hours during a period of dry-weather and stable-flow conditions at the Chattahoochee River at Paces Ferry Road on August 4–5, 1999. Indicator-bacteria samples were collected according to USGS protocols for the equal-width-increment technique and using isokinetic samplers (Wilde and others, 1999). Except for two grab samples, all water samples were composites of multiple vertical samples at each site. Samples were chilled immediately after collection and hold times were typically less than 4 hours. Indicator-bacteria concentrations were deter-

Table 1. Georgia fecal-coliform standards and U.S. Environmental Protection Agency recommended criterion and standards for indicator bacteria  
[—, no standard or criterion has been set]

Indicator bacteria	Time period that standards and criterion apply	Georgia fecal-coliform bacteria standards <sup>1/</sup>		U.S. Environmental Protection Agency		
		30-day geometric mean <sup>4/</sup>	Single-sample maximum <sup>5/</sup>	Criterion <sup>2/</sup>	Standards <sup>3/</sup>	
				Single sample <sup>5/</sup>	30-day geometric mean <sup>d</sup>	Single-sample maximum
Fecal-coliform bacteria	May–October <sup>6/</sup>	200	—	400	—	—
	November–April	1,000	4,000	—	—	—
<i>E. coli</i>	year round	—	—	—	126	235
Enterococci	year round	—	—	—	33	61

<sup>1/</sup>Georgia Environmental Protection Division (2000)

<sup>2/</sup>U.S. Environmental Protection Agency (1997)

<sup>3/</sup>U.S. Environmental Protection Agency (1986a and b)

<sup>4/</sup>Based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. The geometric mean of a series of N terms is the N<sup>th</sup> root of their product. For example, the geometric mean of 2 and 18 is 6—the square root of 36.

<sup>5/</sup>Georgia waters are deemed **not supporting** designated uses (impaired) when 25 percent or more samples have fecal-coliform bacteria concentrations greater than the applicable review criterion or standard (400 or 4,000 col/100 mL) and **partially supporting** when 11 to 25 percent of samples exceed the review criterion or standard.

<sup>6/</sup>In Georgia regulations for water-quality control, May–October is defined as the period when water contact recreation activities are expected to occur. The State of Georgia does not encourage swimming in surface waters since a number of factors which are beyond the control of any State regulatory agency contribute to elevated levels of fecal-coliform bacteria.

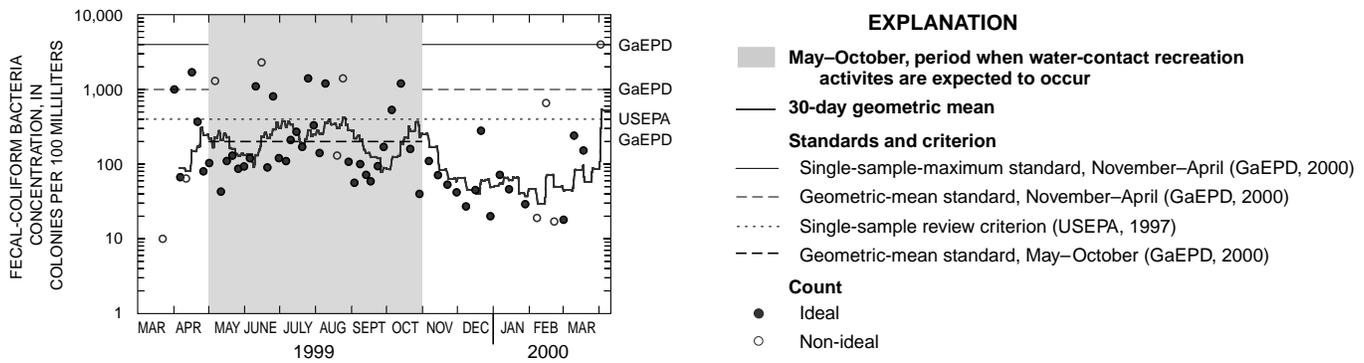


Figure 2. Temporal variations of fecal-coliform bacteria concentrations in the Chattahoochee River at Atlanta (Paces Ferry Road), March 1999–April 2000.

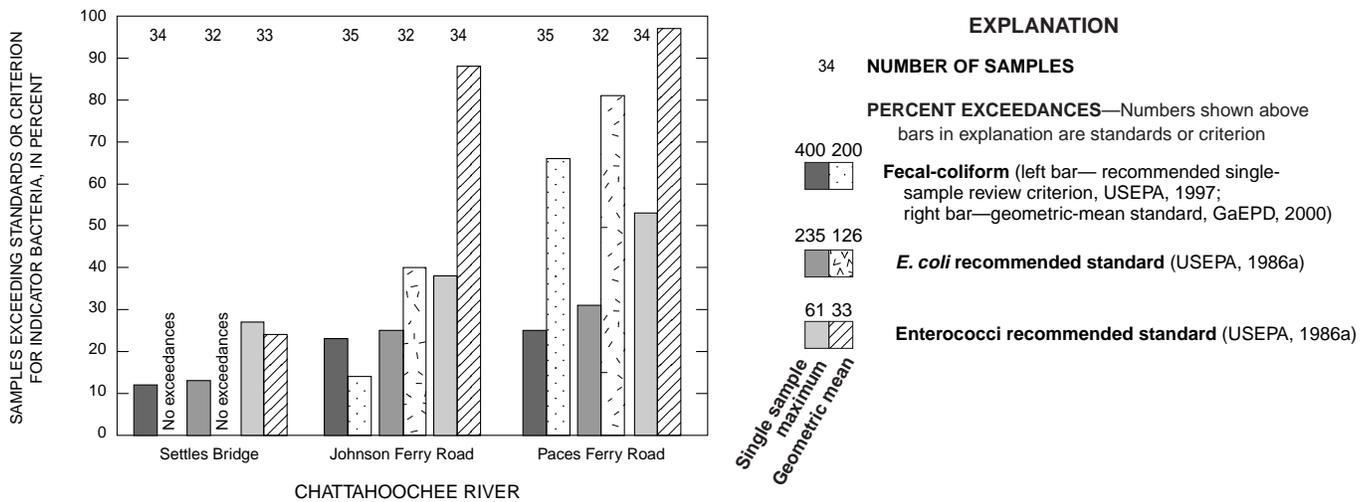


Figure 3. Percentage of samples exceeding standards or criterion for indicator bacteria at three Chattahoochee River sites, May–October 1999.

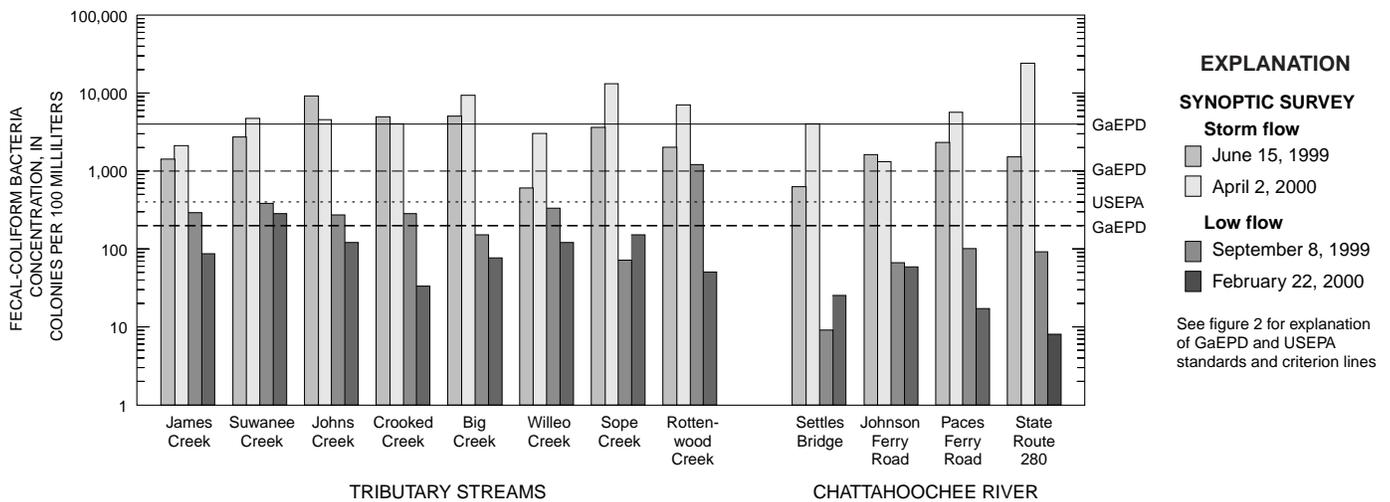


Figure 4. Fecal-coliform bacteria concentrations in water samples collected during four synoptic surveys of selected sites in the study area, 1999–2000.

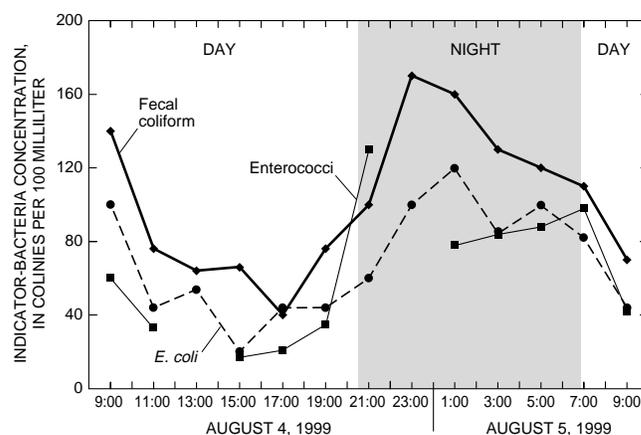
mined using the membrane filtration procedure using m-FC media for fecal-coliform bacteria, m-TEC media for *E. coli*, and EIA media for enterococci (Myers and Wilde, 1999).

## Results

The geometric-mean of fecal-coliform bacteria concentrations commonly exceeded GaEPD standards in samples collected from the Chattahoochee River at Paces Ferry Road (fig. 2), especially during May to October 1999 when water-contact recreation activities are expected to occur. In the reach of the Chattahoochee River which flows through Metropolitan Atlanta, indicator-bacteria concentrations in water samples and the percentage of samples exceeding bacteria standards increased from the upstream monitoring site at Settles Bridge to the downstream monitoring site at Paces Ferry Road. From May to October 1999, the percentage of samples exceeding the geometric-mean standards (table 1) at the three routine monitoring sites ranged from 0 to 66 percent for fecal-coliform bacteria, from 0 to 81 percent for *E. coli*, and from 24 to 97 percent for enterococci (fig. 3).

Synoptic surveys indicated lowest fecal-coliform bacteria concentrations occurred in the Chattahoochee River and tributaries during low-flow conditions; whereas, the highest fecal-coliform bacteria concentrations occurred during storm-flow conditions (fig. 4). During low-flow conditions, fecal-coliform bacteria concentrations in tributary streams were generally higher than concentrations in the Chattahoochee River; during storm-flow conditions—the same relation is true. In all storm-flow synoptic samples, the USEPA recommended single-sample review criterion of 400 col/100 mL for fecal-coliform bacteria was exceeded. During low-flow conditions, indicator-bacteria concentrations generally were 1 to 2 orders of magnitude less than concentrations measured during the two storm-flow synoptic surveys. One low-flow synoptic sample collected at Rottenwood Creek exceeded the USEPA recommended review criterion.

During diurnal sampling, indicator-bacteria concentrations were lowest during the late afternoon, following the period of most intense sunlight, and highest during the night (fig. 5). Concentrations of fecal-coliform bacteria, *E. coli*, and enterococci were approximately 4, 6, and 8 times higher, respectively, during the night than when sunlight intensity was highest. Daily fluctuations in sunlight intensity may be a source of variability in indicator-bacteria concentrations during low-flow conditions and in shallow water.



**Figure 5. Diurnal variation in indicator-bacteria concentrations in the Chattahoochee River at Atlanta (Paces Ferry Road), August 4 and 5, 1999.**

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