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Increased Recovery Rate of Salmonellae from Stream Bottom Sediments Versus Surface Waters

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Salmonella recovery rates for stream bottom sediments were observed to be higher than those from surface water.

Much of our concern today for the presence of enteric pathogens in our surface waters is largely due to the increasing demands which are being placed upon this resource. Techniques have been developed which increase recovery rates of the occasional *Salmonella* or *Shigella* which can be found in high-quality surface water (4, 9), but the lack of their recovery does not preclude their presence at a particular sampling point.

In light of the increasing number of reports which suggest growth and multiplication of the coliform group of bacteria in natural waters (5, 7, 8) and that river and lake bottom sediments will stimulate their rate of growth (2, 6), we speculated that recovery yields of pathogenic enteric bacteria might be higher than usually reported for surface waters if river bottom sediments were concomitantly sampled. For this study, we selected several locations on the North Oconee River (Clarke County, Ga.) below an unchlorinated, treated sewage outfall for periodic water and bottom sediment collection (Fig. 1). Samples were collected from each location by techniques suggested by the American Public Health Association (1) and enriched for the *Salmonella-Shigella* group of organisms in Selenite Broth (Difco). Ten grams (wet weight) of sediment was inoculated into tubes containing 1 ml of the enrichment broth, whereas 1 liter of river water was filtered through a 0.45-μm (HA) filter disc (Millipore Corp.). The filter disc was then placed into a similar Selenite Broth tube. After 18 hr of incubation at 37 C, samples of the enriched cultures were streaked to MacConkey Agar (Difco) for primary isolation. The taxonomic classification of the isolates was made by techniques suggested by Edwards and Ewing (3) and was confirmed serologically by the Enteric Bacteriology Unit, Center for Disease Control, Atlanta, Ga.

The data presented in Table 1 demonstrate that higher recovery yields of *Salmonella* can be achieved from bottom sediments than from surface waters at site C. Of the 195 samples of sediments and river water taken over a 1-year period, approximately 90% of the *Salmonella* species recovered were found in the bottom sediments. Explanations for this observation are difficult

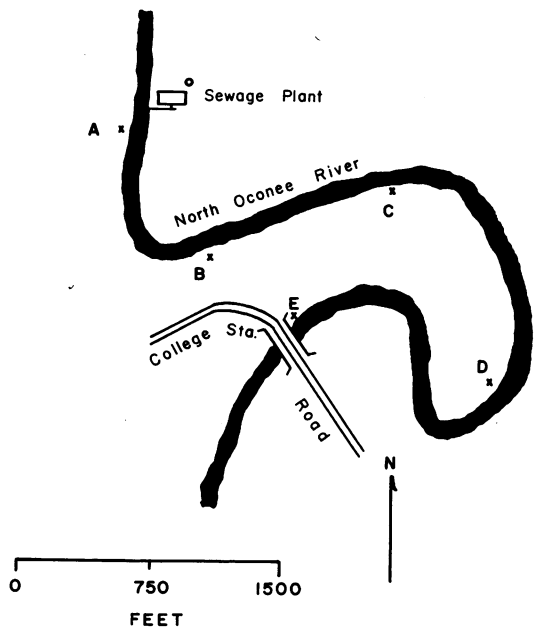

FIG. 1. *Site location for the collection of water and bottom sediments from the North Oconee River (Clarke County, Ga.)*

since a variety of both physical and biological phenomena could be responsible for the recovery. It is entirely possible that sedimentation and adsorption of the organisms to the sands and clays could concentrate bacteria on the stream bottom. This phenomenon could in itself increase the recovery yields of any desired bacterial species and, if the organism could find suitable nutrients present, growth might occur to further increase

TABLE 1. *Salmonella recovered from water and bottom sediments of the North Oconee River*[a]

Source	Samples taken	*Salmonella* recovered		*Salmonella* sp. isolated
		No.	Per cent	
River water	195	1	0.6	
Site C	39	1	2.6	1 *S. enteritidis* ser. *anatum*
Bottom sediments	195	9	4.6	
Site C	39	8	20.1	3 *S. enteritidis* ser. *anatum* 4 *S. enteritidis* ser. *indiana* 1 *S. enteritidis* ser. *meleagridis*
Site E	39	1	2.6	1 *S. enteritidis* ser. *irdiana*

[a] Thirty-nine samples of water and of sediments were recovered from each of the five sites (195 samples each total).

recovery yields. It is interesting to note that 8 of the 10 *Salmonella* were recovered when mid-day water temperatures were above 24.0 C, since we have demonstrated in our laboratory that prototrophic strains of *Salmonella senftenberg* and *Shigella flexneri* can metabolize substrates present in aqueous extracts of bottom sediments at this temperature and below. Although procedures used in this study were adequate for the recovery of shigellae, none could be detected on the primary isolation media from any of the study sites.

It is also of interest that nine *Salmonella* were recovered from the site C location. The lack of adequate mixing and dispersal of the organisms present in the sewage with the river water was probably responsible for the lack of *Salmonella* recovery at the upper two sites. No explanation is readily available for lower recovery rates at sites below C, unless substantial precipitation and adsorption of the organisms to the bottom sediments occurred in the site C area to preclude recovery downstream.

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