

Evidence of Fecal Pollution of Streams in Northwestern Mississippi

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The presence of enteric bacteria in water is usually regarded as evidence of recent fecal contamination of water (APHA 1971; REVELLE and REVELLE 1974). From the relative populations of fecal coliform bacteria (FC) and fecal streptococci (FS) in polluted water, GELDREICH and KENNER (1969) established the criteria for differentiating various sources of fecal wastes polluting water; FC:FS ratios of 4.00 or greater indicate water contamination by human fecal wastes whereas ratios of 1.00 or less indicate water contamination by fecal wastes from a variety of homeothermic animals comprising birds and terrestrial mammals. Intermediate ratios result from mixtures of varying proportions of human and animal fecal wastes in polluted water. On the basis of these criteria, SMITH and TWEDT (1973) determined the probable sources and population patterns of enterobacterial pollutants of rivers in southeastern Michigan. The findings reported here were obtained from a recent, preliminary survey of the microbial parameter in source water pollution in northwestern Mississippi.

MATERIALS AND METHODS

The survey covered those segments of Coldwater, Tallahatchie, and Yocona rivers emptying into the Arkabutla, Sardis and Enid reservoirs, respectively (Fig. 1). Each river is fed by several tributary creeks, and flows for several miles through rural, agricultural and woodland areas. Several sampling stations, easily accessible by road, were selected along each river. The rivers were sampled from road bridges, and upstream. The sampling technique employed is that described in the Millipore Application Manual (1972). Quarter-samples were collected at each station with the aid of a "LaMotte Chemical" water sampling bottle # 1060. The pH and temperature of the stream at each station were determined at the time of sampling.

Populations of total coliforms (TC), fecal coliforms, and fecal streptococci were determined by

means of the membrane filtration technique as described in the Millipore Application Manual # AM 302 (1972). Total coliforms, fecal coliforms and fecal streptococci were identified with M-Endo MF Broth, M-FC Broth, and Difco M-Enterococcus Agar media, respectively. Presterilized 47 mm filters (Millipore # HAWG 047 SO) were used in the tests. A volume of 0.50 ml of each water sample was diluted 1:200 with sterile, phosphate-buffered water (pH 7.20), and then filtered. The mean population of each indicator organism at every sampling station was determined from three representative quarter-samples collected from the station.

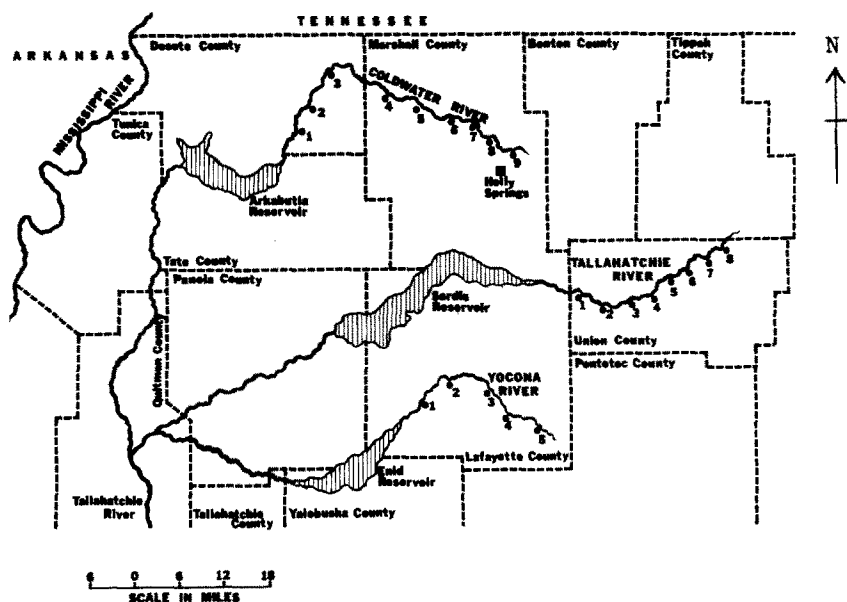


Figure 1. Map of Sampling Area in Northwestern Mississippi. The Sampling Stations are shown numerically on the Coldwater, Tallahatchie and Yocona rivers.

RESULTS AND DISCUSSION

The mean populations of indicator organisms are shown in TABLE I. The populations of total coliforms, fecal coliforms and fecal streptococci were 333 organisms/100 ml or greater at each sampling station, and indicate pollution levels of each kind of organism. Fecal coliforms comprised 5.07%, 5.01% and 4.14% of the populations of total coliforms in the Coldwater, Tallahatchie and Yocona rivers, respectively.

TABLE I

Mean Populations of Indicator Organisms
in the Coldwater (CWR), Tallahatchie (TR)
and Yocona (YR) rivers in Northwestern
Mississippi.

Sampling Stations	Total Coliforms / 100 ml	Fecal Coliforms / 100 ml	Fecal Streptococci / 100 ml	Ratio FC:FS
CWR 1	9,400	466	1,400	0.33
CWR 2	7,600	400	600	0.67
CWR 3	8,666	400	666	0.66
CWR 4	18,000	933	2,800	0.33
CWR 5	8,200	466	1,200	0.39
CWR 6	9,333	400	1,600	0.25
CWR 7	7,200	333	1,400	0.24
CWR 8	10,666	600	1,733	0.35
CWR 9	6,400	333	600	0.56
TR 1	21,800	1,000	1,400	0.71
TR 2	20,666	933	1,400	0.67
TR 3	34,000	1,600	1,466	1.09
TR 4	34,666	1,600	1,200	1.33
TR 5	8,400	600	1,733	0.37
TR 6	8,666	400	1,600	0.25
TR 7	7,333	466	1,800	0.26
TR 8	8,200	600	1,200	0.50
YR 1	12,600	600	900	0.67
YR 2	13,333	400	866	0.46
YR 3	10,666	400	933	0.43
YR 4	9,800	333	800	0.42
YR 5	10,000	600	1,000	0.60

At all sampling stations, except TR 3 and TR 4, the FC:FS ratios were less than 1.00. In accordance with the standards established by GELDREICH and KENNER (1969), the results reported here indicate the fecal pollution of the three studied, most probably by fecal wastes from non-human, homeothermic animals. However, the specific kinds of animals contributing to the pollution of these streams could not be determined from the available data.

FC:FS ratios of 1.09 and 1.33 were obtained at stations TR 3 and TR 4, respectively. Both stations are located in the vicinity of New Albany, a moderately commercial town in Union County. These results point to the possibility of domestic waste as a minor contributor to stream pollution. Further studies are under way to clarify the sources of pollution at these stations. The presence of Salmonella organisms was positively confirmed at the stations.

The stream temperature ranged from 21°C to 24°C in Coldwater river, 24.5°C to 30°C in Tallahatchie river, and 25°C to 28°C in Yocona river; correspondingly the pH ranged from 6.4 to 6.8, 6.7 to 7.2, and 6.5 to 6.9. No correlation was found between bacterial populations and the stream temperature and pH.

The findings reported here are limited by the lack of knowledge of the specific kinds of animals contributing to the fecal pollution of these streams. It is suspected however that the animals in question might include any of the variety of birds and other game animals inhabiting the Holly Springs National Forest Reserve which hedges on the streams and their tributaries. The indicator organism ratios reported by GELDREICH and KENNER (1969), and subsequently employed by SMITH and TWEDT (1973), provide justification for the use of the same standards in determining the most probable sources of fecal contamination of streams as reported here. At any rate, the present survey contributes knowledge to the microbial profile of source water in northwestern Mississippi.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the National Institutes of Health for providing the funds under its MBS program (#RR-8000) for this and continuing

investigation. I thank the following undergraduate student trainees of the MBS program for their participation in the investigation: Miss Gloria Richardson, Miss Joyce Logan, Mr. Eddy Blossom.

REFERENCES

APHA (American Public Health Association): Standard Methods for the Examination of Water and Waste-water. 13th ed., American Public Health Association, Washington, D.C. (1971)

GELDREICH, E.E. and B.A.KENNER: J. Water Poll. Control Fed., 41, R336. (1969)

MILLIPORE CORPORATION: Biological Analysis of Water and Waste-water; Manual #AM 302. Millipore Corporation, Bedford, Massachusetts. (1972)

REVELLE, C. and P.REVELLE: Sourcebook on the Environment. 1st ed., Houghton Mifflin Company, Boston, Massachusetts. (1974)

SMITH, R.J. and R.M.TWEDT: In Freshwater Pollution-I; Bacteriological, and Chemical Pollutants. 1st ed., MSS Information Corporation, New York, N.Y. (1973)