Agricultural Research Service

United States Department of Agriculture

National Sedimentation Laboratory

Pre-Project Water Quality of Demonstration Erosion Control (DEC) Watersheds During 1986

S.S. Knight and C.M. Cooper

Technology Applications Project Report No. 3

Not an official Publication

December 1987

Pre-Project Water Quality in Demonstration Erosion Control (DEC) Watersheds in the Yazoo Basin During 1986

Submitted to the DEC Task Force

by

S. S. Knight and C. M. Cooper

Sedimentation Laboratory

Agricultural Research Service

United States Department of Agriculture

Pre-Project Water Quality in Demonstration Erosion Control (DEC) Watersheds in the Yazoo Basin During 1986 [1] [2]

S. S. Knight and C. M. Cooper [3]

---

[1] Contribution of the Sedimentation Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Oxford, MS.

[2] Report submitted to Demonstration Erosion Control Task Force.

[3] Ecologists, U. S. Department of Agriculture, Agricultural Research Service, Sedimentation Laboratory, Oxford, MS. 38655

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Data were collected on six bluffline streams as part of a pre-construction documentation of water quality in the Demonstration Erosion Control (DEC) Project watersheds in the Yazoo Basin. The watersheds chosen for comprehensive land treatment and channel stability programs have serious upland and channel erosion problems. Although data collection began in summer, 1985, this report concerns only 1986 information and emphasizes annual trends in water quality. Weekly water quality analyses were conducted on two streams during 1986; quarterly sampling on the other four streams provided additional information. No water quality parameter measured exceeded acceptable limits for streams in the southeastern United States inhabited by warm water fishes. The pH was slightly acidic as is normal in watersheds with acidic soils. Suspended sediment increases were limited to runoff event related phenomena. Nitrogen and phosphorus concentration increases followed spring plowing and fertilizer application. Point source nutrient input from Water Valley, Mississippi, was measurable throughout the year. It was not considered adverse because of the oligotrophic nature of the stream. Coliform bacterial counts from warm-blooded animal origin were high, which is common for streams in this region. Human fecal coliform contamination occurred in less than 5 percent of samples taken. Pre-construction water quality research will give documentation of watershed changes as the project progresses.

INTRODUCTION

Background and Purpose

The Demonstration Erosion Control (DEC) Project in the Yazoo Basin was proposed by the U. S. Congress in 1984 in response to continuing erosion problems in lands and stream channels of piedmont and hills. The DEC project was organized as an interagency effort to combine technology and resources of research and action agencies, producing a watershed system approach for better land and water resource management.

Congress directed the U. S. Army Corps of Engineers and the USDA Soil Conservation Service to develop six demonstration watersheds where systematic watershed and flood control programs could be developed. Other research or service agencies, including the Agricultural Research Service, U. S. Army Engineers Waterways Experiment Station and the U. S. Geological Survey, were requested to participate in the project in various capacities. The USDA-ARS Sedimentation Laboratory is participating in DEC by documenting pre-project conditions, evaluating the efficiency of specific watershed management practices and structural measures, and documenting project progress.

Baseline water quality research began in 1985 (Knight and Cooper, 1987) with emphasis on repetitive quarterly sampling of several selected sites on all six watersheds and weekly sampling on Long and Otoucalofa Creeks. The purpose of this report is to analyze water quality information collected in 1986 and document water quality conditions. Report emphasis will be on annual cycles and trends during 1986. All information contained in this report is preliminary and is subject to further evaluation.

Watershed descriptions and sampling locations

The loess hills of northern Mississippi, where the demonstration watersheds are located (Fig. 1), are highly erosive. Since streams have little or no bed controls and the hill land region ends in an abrupt bluffline at the Mississippi alluvial delta, channels become deeply incised and unstable.

Hickahala-Senatobia Creek watershed (54,700 ha), the northern-most of the 6 demonstraation projects, was sampled quarterly at 6 sites (Fig. 2). Sites 1 and 2 were below the confluence of the two creeks and also downstream from the city of Senatobia. Two additional sites were sampled on each of the 2 creeks above their confluence.

Hotophia Creek (Fig. 3), the smallest of the watershed drainages (8,500 ha), enters the Little Tallahatchie River

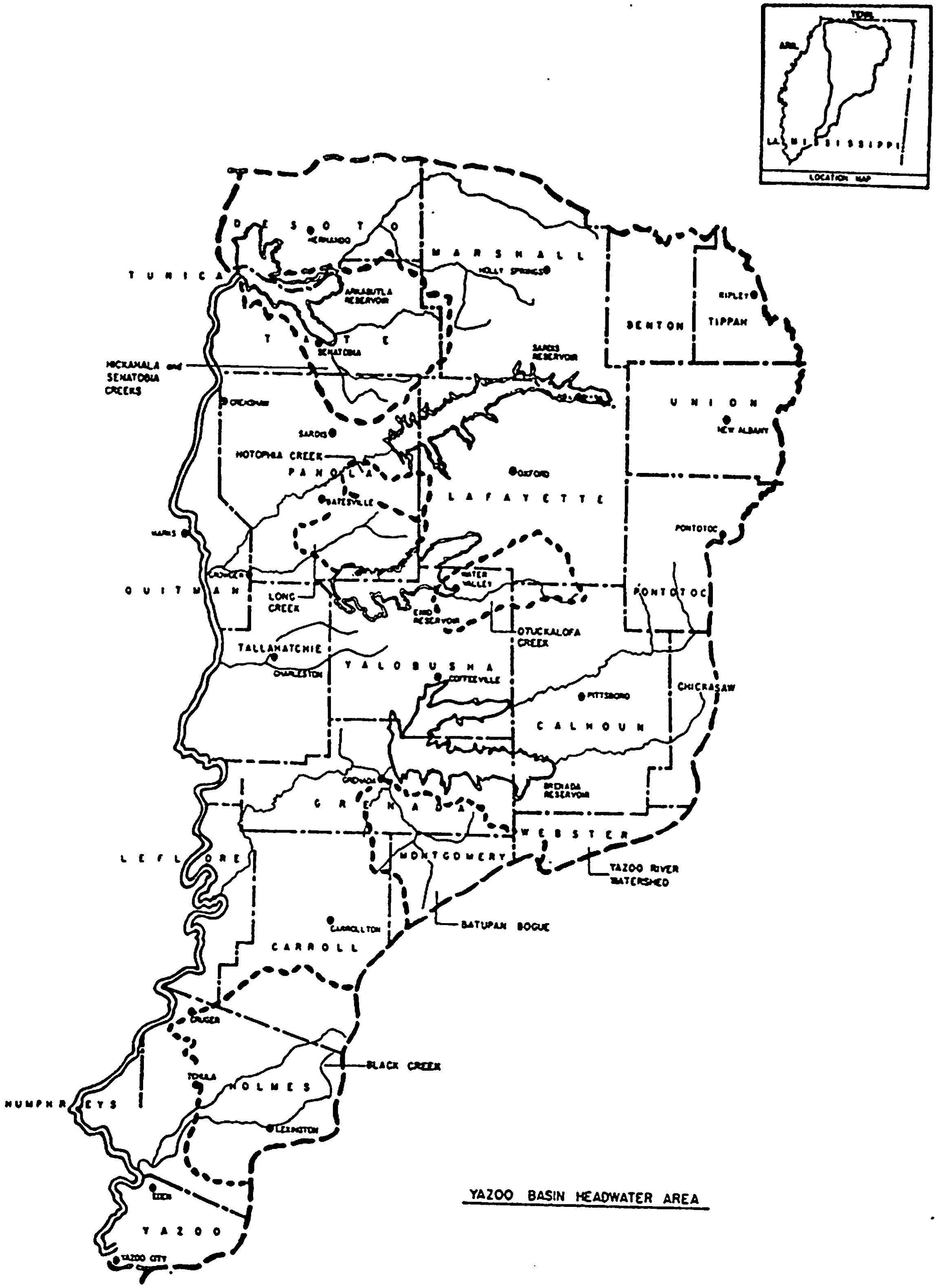


Figure 1. Map of the Yazoo Basin foothills with major stream drainage and 6 DEC watersheds.

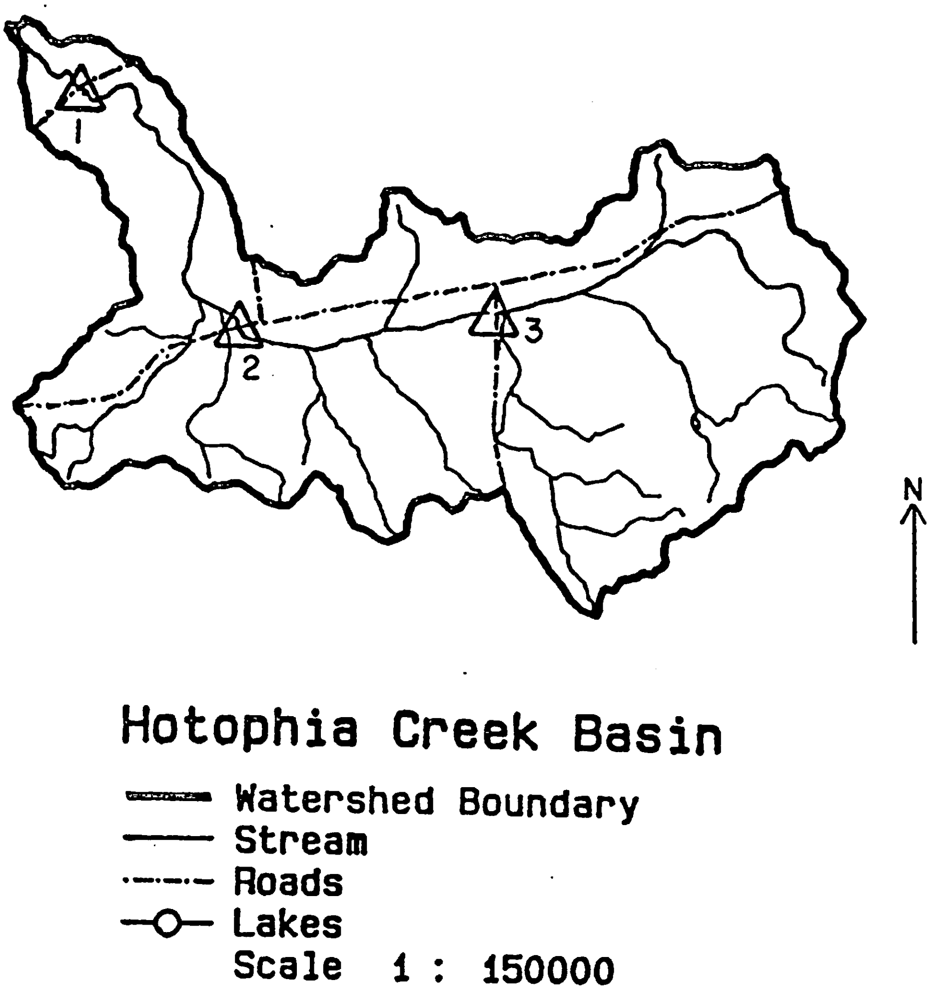


Figure 3. Map of Hotophia Creek, including quarterly water quality sampling sites.

downstream of Sardis Lake. It was sampled quarterly at 3 sites during 1986.

Long Creek watershed (22,399 ha) was sampled weekly during 1986 at 8 sites. The sites were located (Fig 4) so that they measured water quality from Long Creek proper and from major tributaries, including Johnson Creek (# 4), Goodwin Creek (# 5), and Caney Creek (# 7). Long Creek drains into the Yocona River at the loess hill bluffline.

Otoucalofa Creek (29,000 ha) flows into the Yocona River (Fig. 5) within the boundary of Enid Lake. It was sampled weekly at 7 sites. One site (2) was located in an urban tributary and another on a rural subwatershed (# 6). Site #1, below the town of Water Valley, was sampled to determine urban influence.

Batupan Bogue (66,000 ha) flows into the Yalobusha River downstream of Grenada Lake (Fig. 6). It was sampled at six sites.

Black Creek (89,000 ha), the southern-most of the watersheds, enters the Yazoo River as part of the Hillside Floodway near Howard, Mississippi (Fig. 7). Sampling included sites on Fannegusha and Black Creeks and Harland Creek (# 7) a highly erosive tributary.

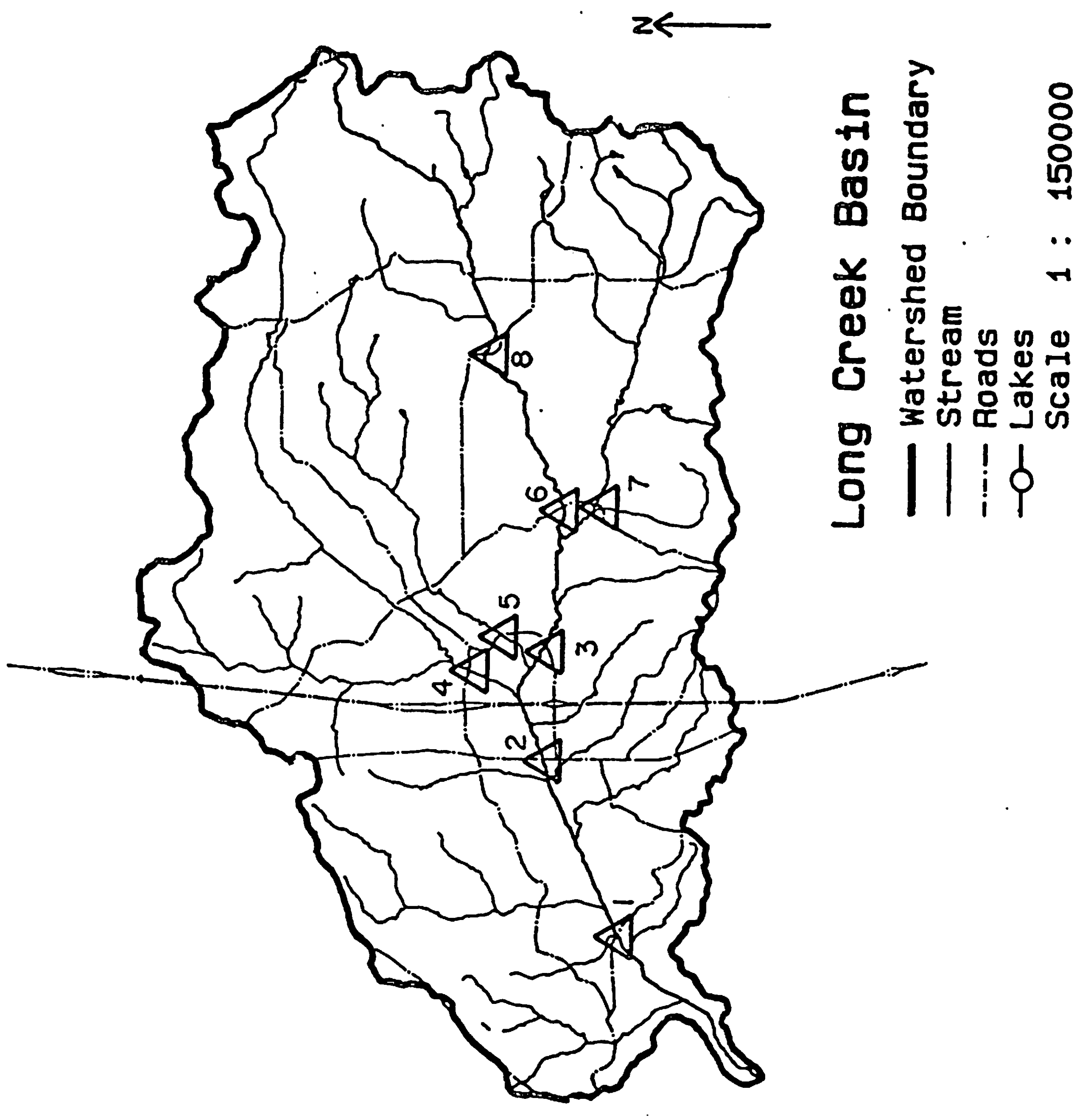


Figure 4. Map of Long Creek, including quarterly water quality sampling sites.

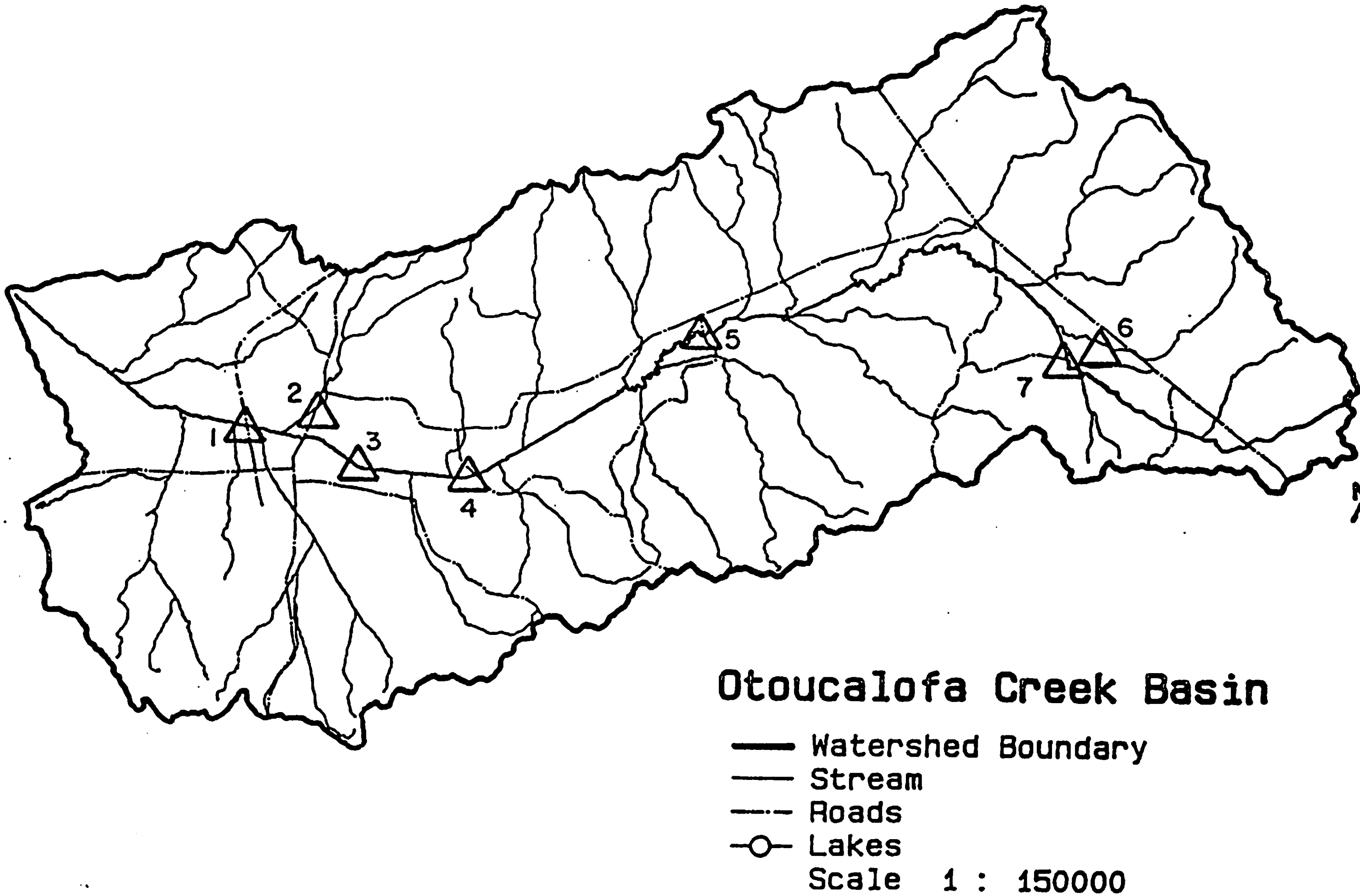


Figure 5. Map of Otoucalofa Creek, including quarterly water quality sampling sites.

SAMPLE ANALYSIS

Sites descriptive of watershed and subwatershed water quality were sampled weekly on Otoucalofa and Long Creeks during 1986. Similar sites were sampled quarterly by grab sampling from the 4 other DEC watersheds.

Temperature, conductivity, dissolved oxygen, and pH were measured by electronic water quality meters calibrated before each trip. Total solids, suspended solids, dissolved solids, nutrients and coliforms were analyzed by standard methods (APHA, 1975; USEPA, 1974).

RESULTS AND DISCUSSION

Physical Data

Temperature - All plants and animals have a limited range of temperature in which they can survive. Since temperature extremes can easily have an adverse effect on stenothermic organisms, it is important in maintaining the viability of aquatic ecosystems. Temperature also plays a dual role in determining the health of aquatic systems since, to a great extent, it controls gas solubility in water; the most important of these gases being oxygen.

The mean annual temperature for all DEC watersheds averaged between 16 and 20 ^{o}C; however, temperature ranges in some creeks were considerably more variable than others (Fig. 8).

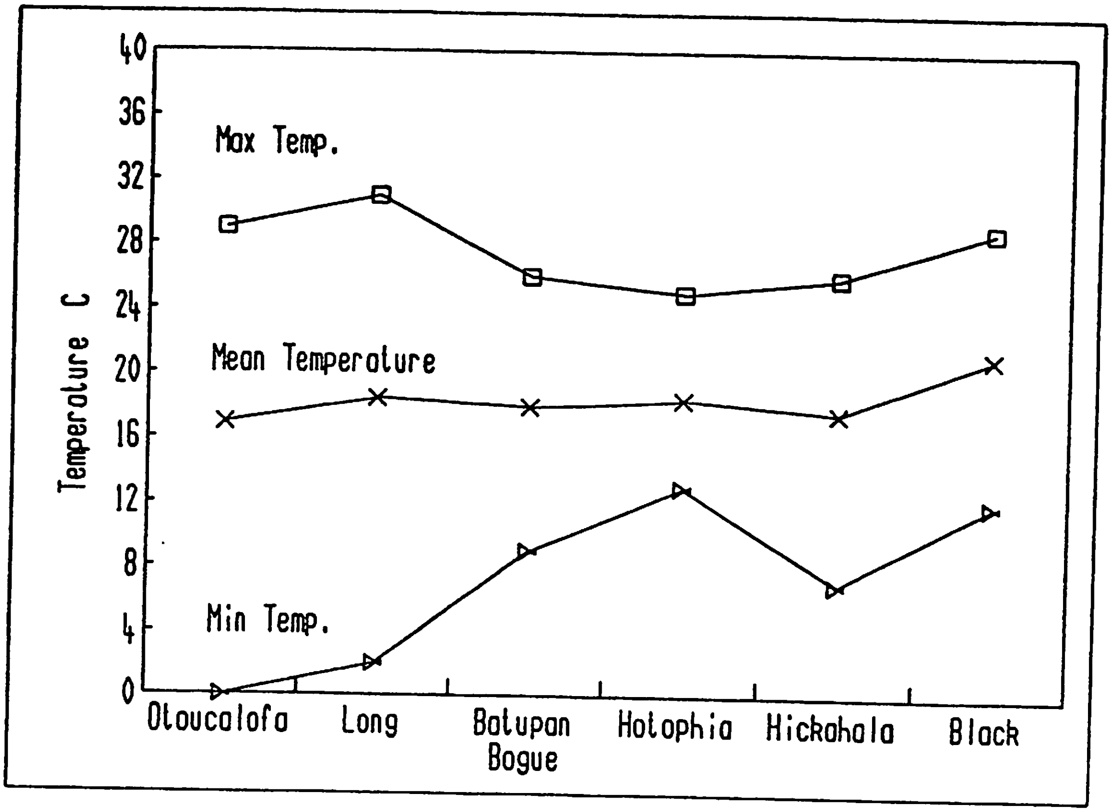
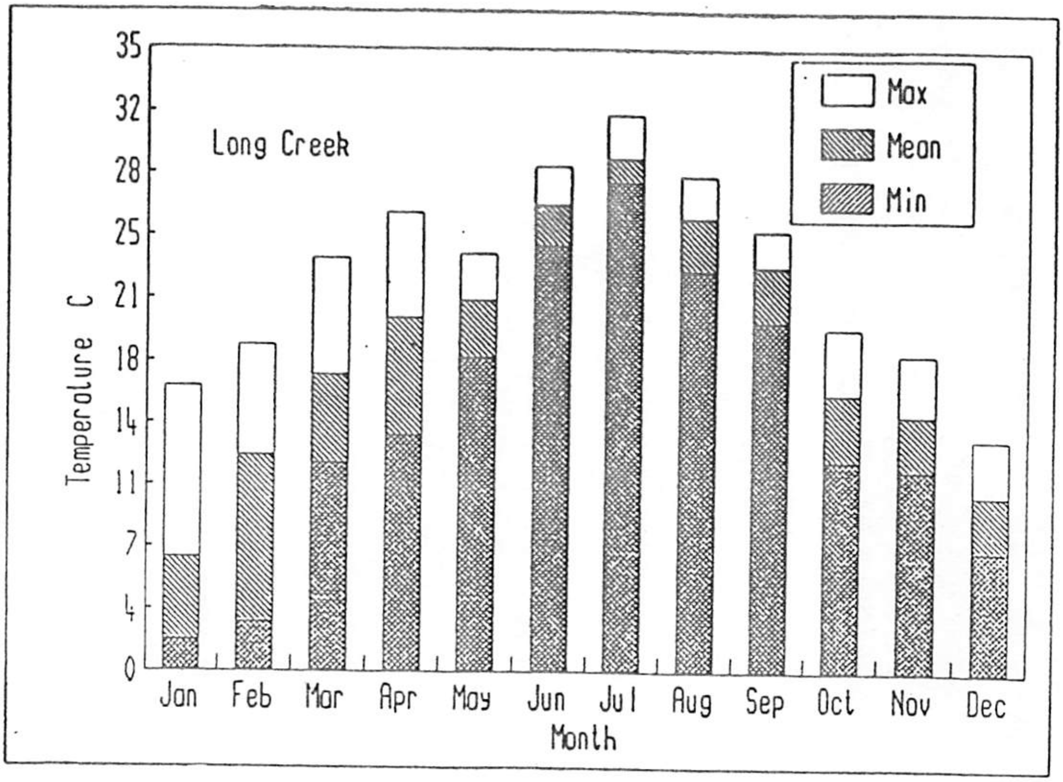


Figure 8. Yearly mean temperatures for all DEC watersheds during 1986.

Of the creeks sampled weekly, Long Creek's yearly mean temperature of 18.5 °C was significantly higher (P>.001) than Otoucalofa Creek's yearly mean temperature of 16.7 °C. Both of these creeks exhibited significant differences (P>.001) between monthly mean temperatures with the highest monthly means of 25.9 and 29.0 °C for Otoucalofa and Long Creeks ,respectively, occurring in July and the lowest monthly means of 5.0 and 7.2 °C occurring in January. Monthly temperature patterns followed expected trends with highs in the summer months and lows in the winter months (Fig. 9). No significant site to site differences were observed for either creek.



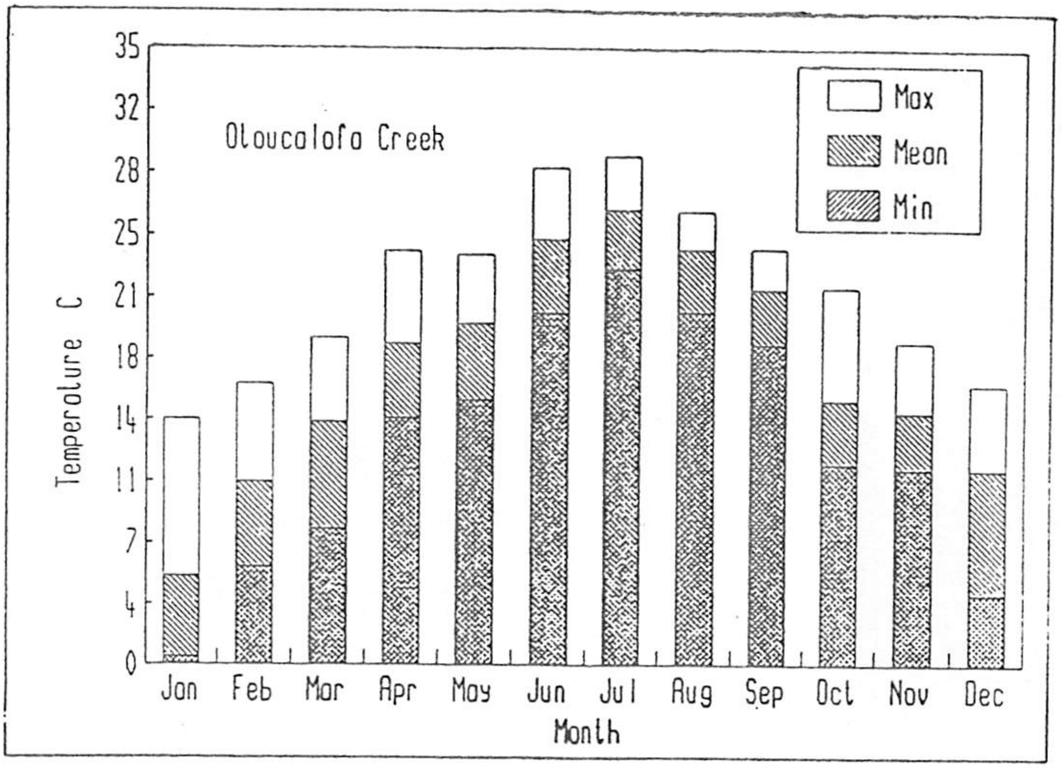


Figure 9. Monthly mean, maximum and minimum temperatures for Otoucalofa and Long Creeks during 1986.

No significant differences were measured in yearly mean temperatures for any creek sampled quarterly (Fig. 8) or from site to site within any of the creeks.

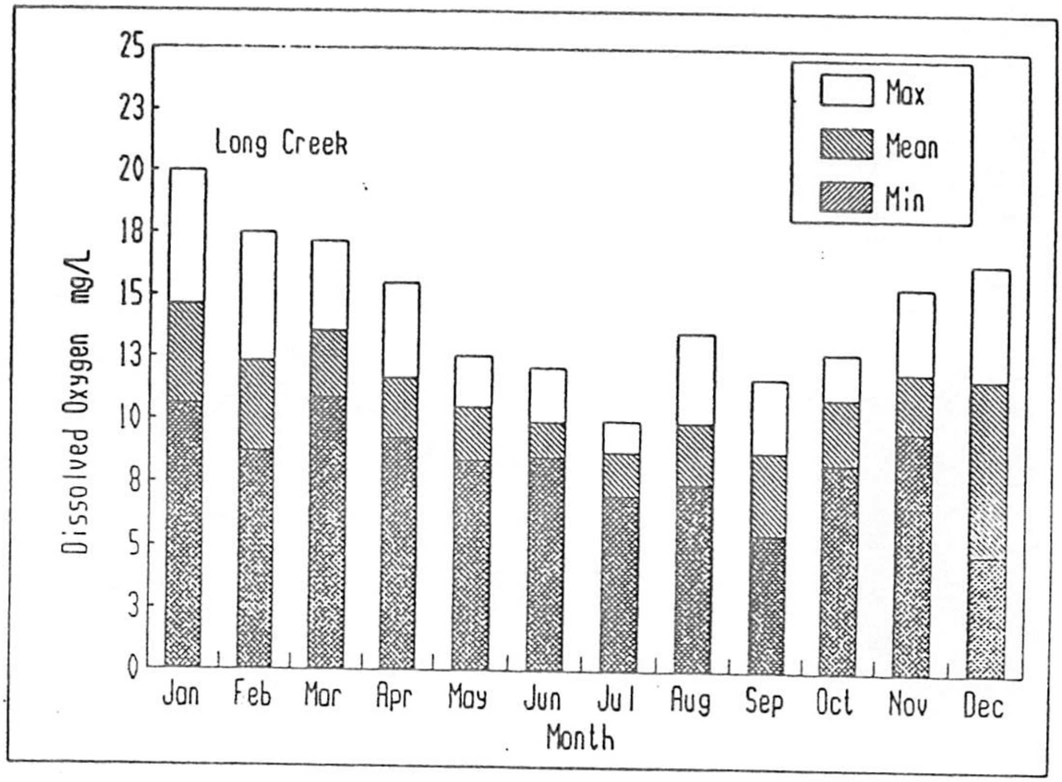
Although temperature extremes from 31.2 to 1.7 °C were measured, these temperatures were not detrimental to the flora and fauna endemic to northern Mississippi streams. Temperature changes occurred at a rate slow enough to allow organisms to adapt without the adverse effects associated with temperature shifts.

Dissolved Oxygen - Other than perhaps water itself, oxygen is the single most important factor in aquatic systems. With the exception of some anaerobic microorganisms, it is essential to all aquatic life, which includes plants as well as animals. Because oxygen is so important to aquatic organisms, factors affecting oxygen solubility and concentration play an important role in determining the distribution and well being of aquatic life.

The annual mean dissolved oxygen concentration of 11.3 mg/L for Long Creek was significantly higher ($P>.001$) than 8.8 mg/L, the annual mean concentration for Otoucalofa Creek (Table 1). Both creeks had significantly different monthly mean dissolved oxygen levels, that followed a pattern of higher means in the cooler months and lower concentrations in the warmer summer months (Fig. 10). No significant site

Table 1. Yearly means of physical parameters and ranges (in parenthesis) for all DEC watersheds during 1986.

Creek	Parameter			
	Temperature °C	Conductivity umhos/cm	D.O. mg/L	pH
Otoucalofa	16.9 (0.4 - 29.0)	53 (10 - 192)	8.8 (3.9 - 16.8)	6.1 (5.2 - 7.4)
Long	18.4 (1.5 - 31.4)	56 (125 - 139)	11.3 (4.8 - 20.0)	6.9 (5.5 - 7.8)
Batupan Bogue	17.8 (9.5 - 25.8)	76 (40 - 175)	9.0 (7.8 - 11.0)	6.5 (6.1 - 7.2)
Hotophia	18.5 (12.9 - 24.6)	37 (15 - 67)	11.1 (6.6 - 16.7)	6.9 (6.3 - 7.1)
Hickahala	17.7 (6.8 - 26.1)	41 (13 - 73)	10.2 (7.7 - 13.1)	6.6 (6.2 - 6.9)
Black	21.1 (12.5 - 29.5)	99 (44 - 205)	9.6 (7.1 - 11.7)	6.9 (6.1 - 7.6)



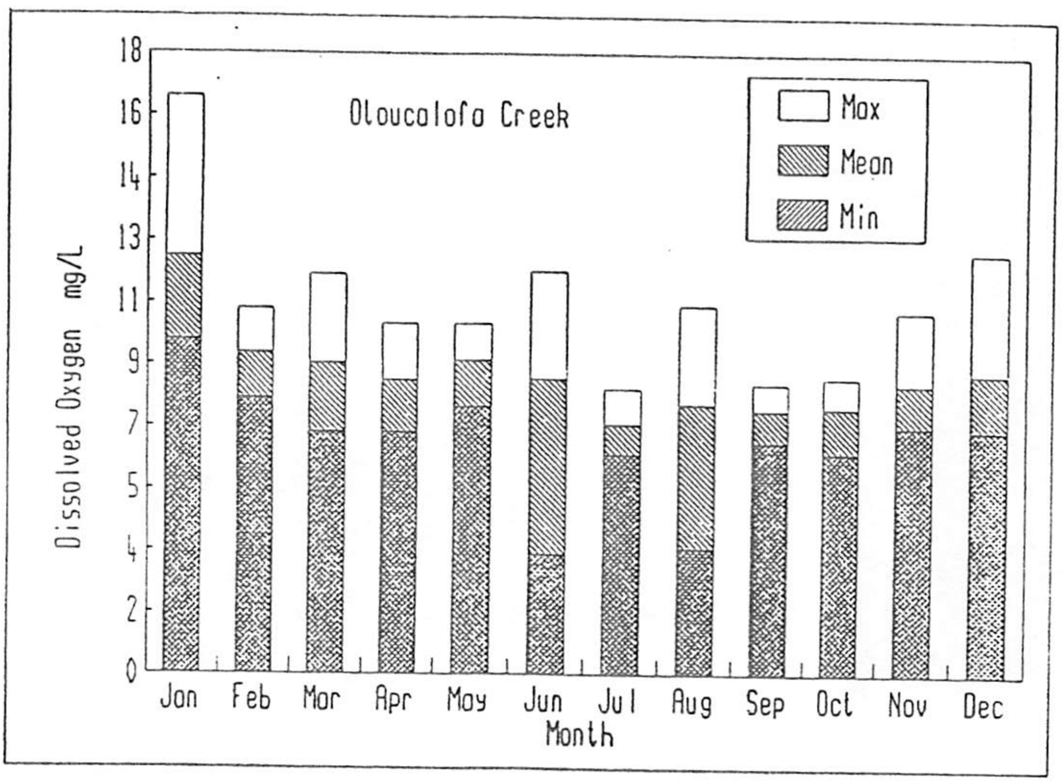


Figure 10. Monthly mean, maximum and minimum dissolved oxygen concentrations for Otoucalofa and Long Creeks during 1986.

to site differences were measured in dissolved oxygen levels.

Hotophia Creek's yearly average dissolved oxygen concentration (12.7 mg/L) was significantly higher (P>.001) than other creeks sampled quarterly (Fig. 11). This isexpected because Hotophia Creek, being shallow and wide, has a higher average surface to volume ratio than the other creeks. Site to site differences in creeks sampled quarterly were found only in Hickahala Creek where head

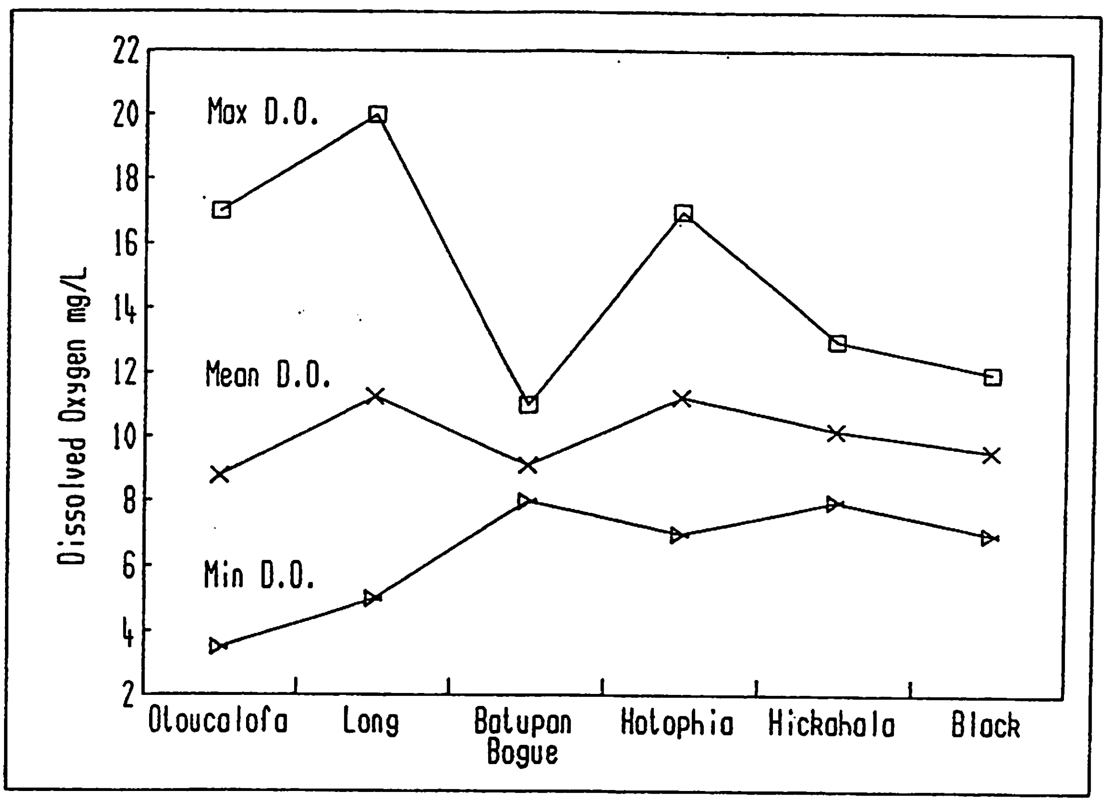


Figure 11. Yearly mean, maximum and minimum dissolved oxygen concentrations all DEC watersheds during 1986.

water sites 4 and 5 had significantly higher dissolved oxygen levels than other sites in the watershed.

Dissolved oxygen levels were normally above 4 mg/L which is generally accepted as adequate for maintaining aquatic organisms adapted to warmwater streams; however, dissolved oxygen decreased to 3.9 mg/L once during June in the Otoucalofa Creek watershed at one site. This drop occurred on an ephemeral tributary (#6) to the main channel of Otoucalofa Creek during a period of dry weather where the tributary had formed a series of stagnant pools. In this case, the lack of available habitat caused by water deficit probably created more stress on aquatic life than the low dissolved oxygen concentrations.

pH - Although some aquatic organisms have been found in waters ranging in pH from 2 to 10, most plants and animals can not tolerate such pH extremes. Natural waters with a pH no lower than 4 or no higher than 9.5 may support healthy populations of fish (USEPA 1973); however ,a more reasonable range for fish culture is pH 6-9 (Wedemeyer et al. 1976). Streams in the southeast tend to have somewhat lower pH values than waters in other parts of the country because they have a low buffering capacity and they receive runoff water high in natural organic acids. Fish and other organisms have become adapted to these lower pH levels, and, thus, the natural acidity poses no life threatening problems.

Long Creek's yearly mean pH (6.9) was significantly higher (P>.001) than the mean yearly pH (6.0) for Otoucalofa Creek (Fig. 12). Long Creek had a greater range of pH than any of the DEC creeks with a high of 7.8 and a low of 5.5 (Table 1.). There was no difference in monthly mean pH values for Otoucalofa Creek; however, there were significantly different monthly means for Long Creek although they followed no explainable pattern. No site to site differences were observed on Otoucalofa Creek, but Long Creek's site 5 was significantly higher than all other sites on Long Creek.

Significant creek to creek differences in yearly mean pH values for creeks sampled quarterly were noted, but there were no site to site differences in any creek (Fig. 13).

No pH value was recorded that would adversely effect endemic fish species, although pH values less than 6 were recorded occasionally. Since this condition is a natural occurrence in northern Mississippi waters and aquatic organisms have adapted to these acid pH values, the range of pH values measured during 1986 in the DEC watersheds was not restrictive to aquatic life.

Conductivity and Total Dissolved Solids - Total dissolved solids (TDS) and conductivity or specific conductance are closely related parameters. TDS is an estimate of all

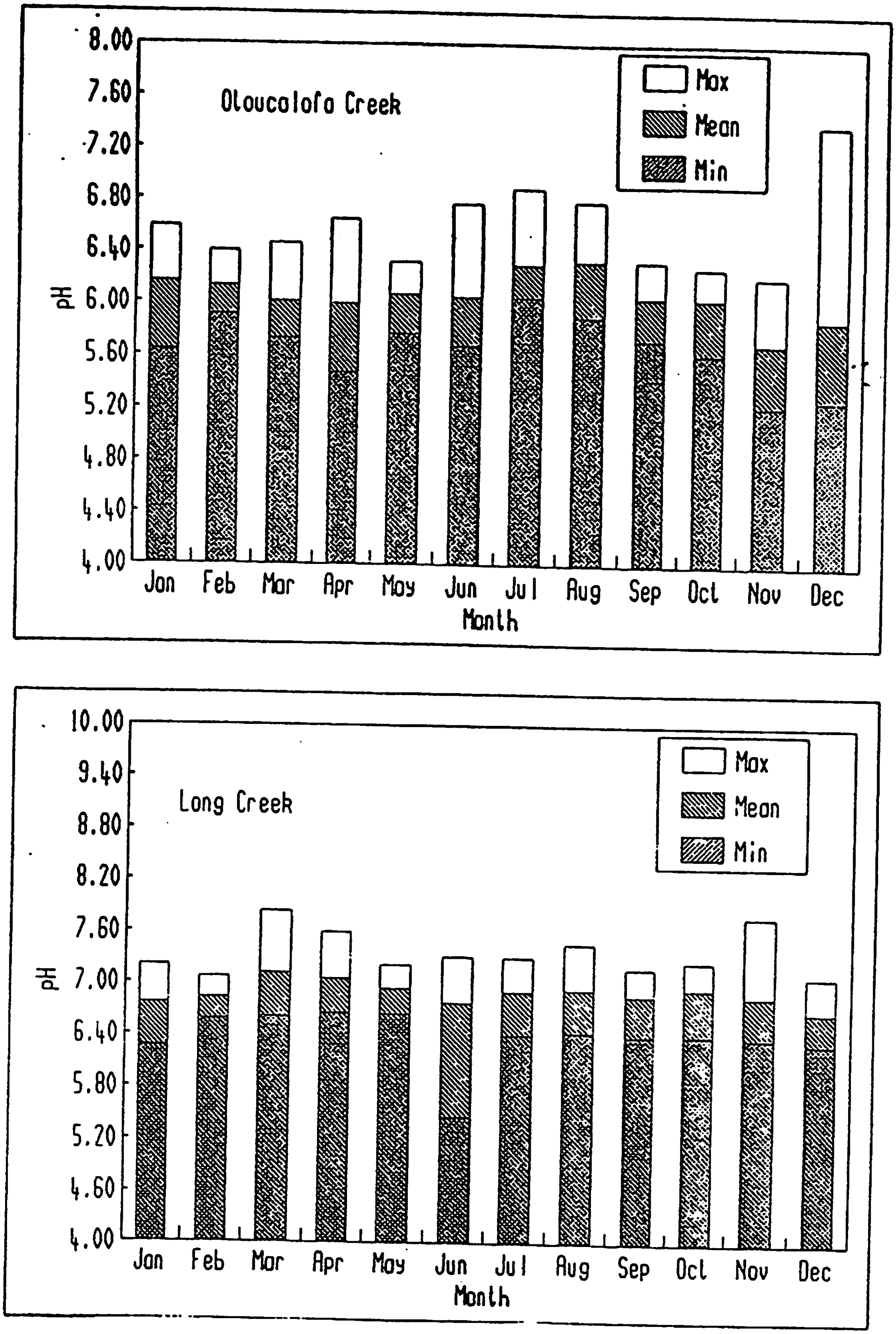


Figure 12. Monthly mean, maximum and minimum pH values for Otoucalofa and Long Creeks during 1986.

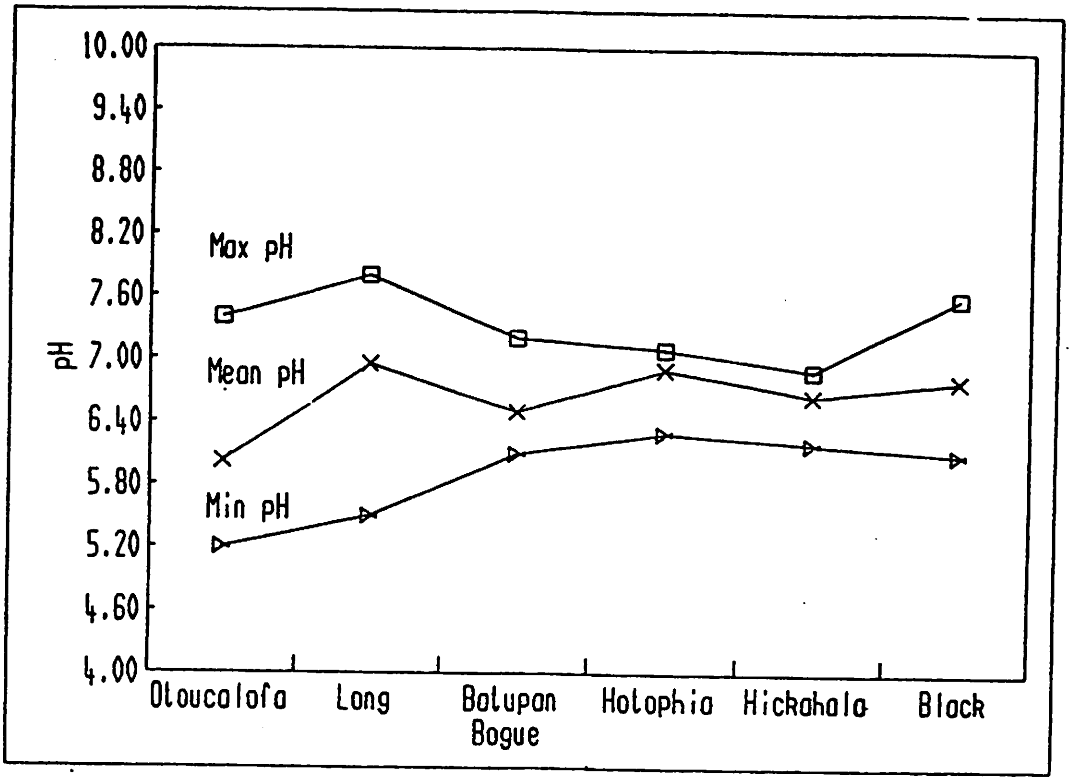


Figure 13. Yearly mean, maximum and minimum pH values for all DEC watersheds during 1986.

salts, as well as other inorganic and organic materials dissolved in water. TDS can affect both ionic regulation in freshwater organisms and the osmotic pressure of water to the point of causing osmoregulatory failure (Wedemeyer 1976). Since ionic materials are the major component of TDS, the higher the level of TDS the lower the resistance to electric current. Measurement of this resistance can be used as an index of TDS content (Cole 1975). Since only a portion of TDS is composed of ionic materials, conductivity may or may not be very closely correlated to TDS.

Long Creek had a significantly (P>.01) higher TDS level of 62.0 mg/L than Otoucalofa Creek with a TDS concentration of 57.0 mg/L. Although Long Creek exhibited the greatest range of TDS (232.0 mg/L to 9.0 mg/L) as compared with the other DEC watersheds, Otoucalofa Creek had a broader range of conductivities (10 to 192 umhos/cm) (Fig. 14).

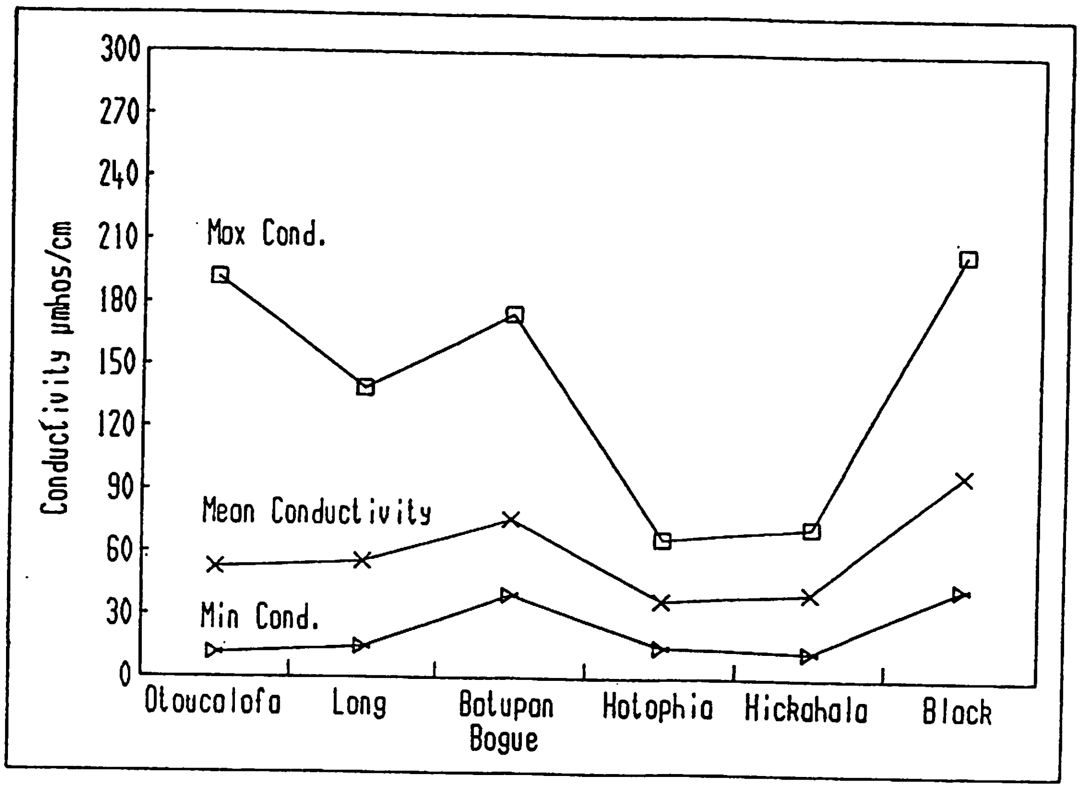


Figure 14. Yearly mean, maximum and minimum conductivities for all DEC watersheds during 1986.

There was no statistical difference measured in conductivity between the two creeks. Means of TDS were significantly different (P>.001) from month to month on Long Creek but not on Otoucalofa. There were also significant differences in conductivity measured as monthly means. Graphs of conductivity and total dissolved solids for both Long and

Otoucalofa Creek show a pattern of slightly higher levels during the dryer summer months (Fig. 15).

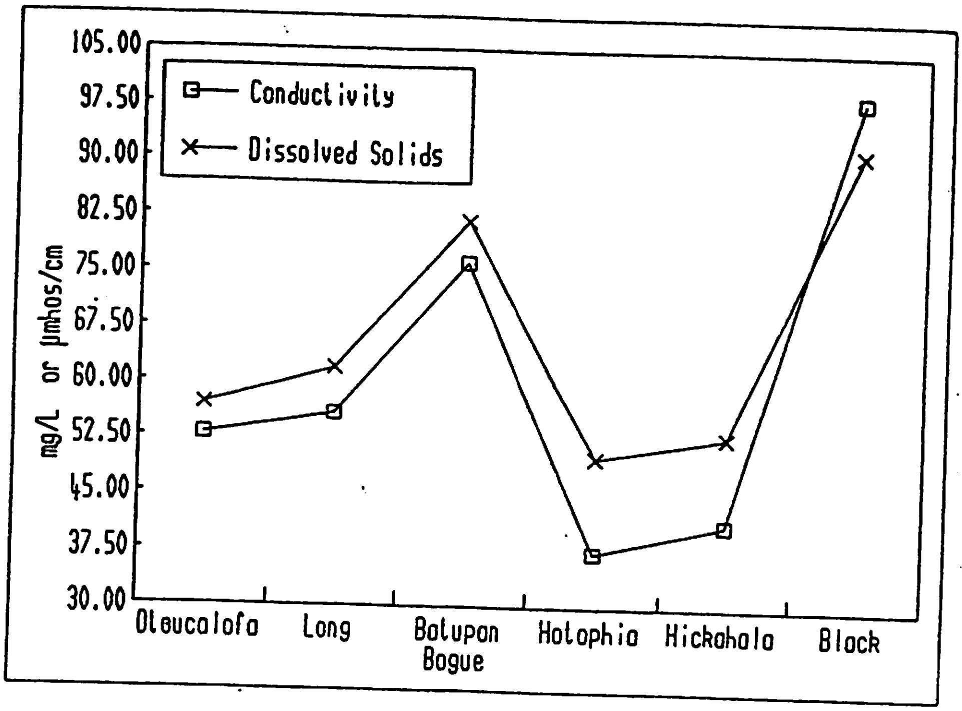


Figure 15. Monthly mean, maximum and minimum total dissolved solids concentrations and mean conductivities for all DEC watersheds during 1986.

Examination of data by sites indicated significant differences in conductivity and TDS on both creeks; however, these differences did not follow any consistent spatial pattern.

Batupan Bogue and Black Creeks had significantly higher yearly mean TDS and conductivity levels than Hickahala and Hotophia Creeks (Fig. 16). There were no site to site differences in conductivity for any of the quarterly samples

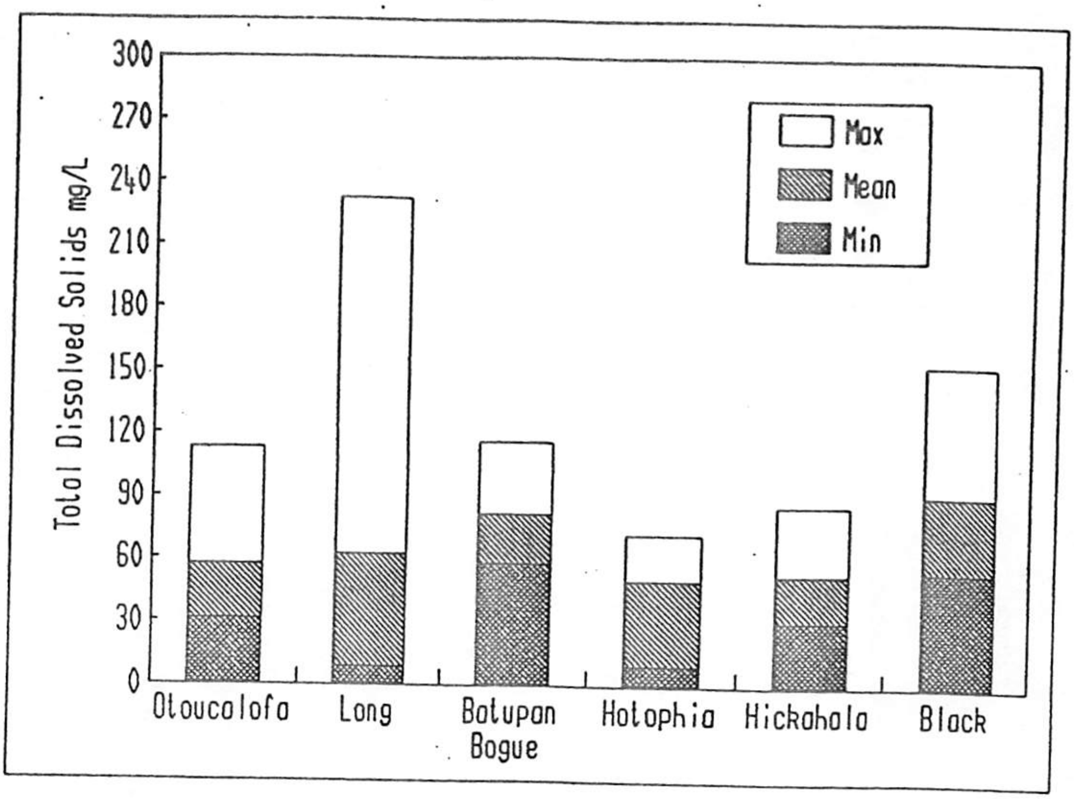


Figure 16. Yearly mean, maximum and minimum total dissolved solids for all DEC watersheds during 1986.

Because the blood and tissues of freshwater fish have a higher concentration of dissolved materials than the water in which they live, they must constantly deal with an osmotic gradient that tends to cause them to take on water. Freshwater fish have adapted to this gradient by expelling vast quantities of fluid while retaining important ions. When the ambient concentration of dissolved material is altered dramatically, fish can not maintain an osmotic balance and die. The USEPA (1973) stated that total dissolved materials should not be changed to the point that characteristic populations of aquatic organisms are significantly altered. Mace (1953) and Rounsefell and Everhart (1953) established an upper tolerance level for TDS at 5,000 to 10,000 mg/L. However, the optimun level of TDS for fish population health and diversity was reported to be between 169 and 400 mg/L (Hart et al. 1945). Neither annual means or upper extremes of TDS ever exceeded these optimum levels of TDS in any of the DEC watersheds.

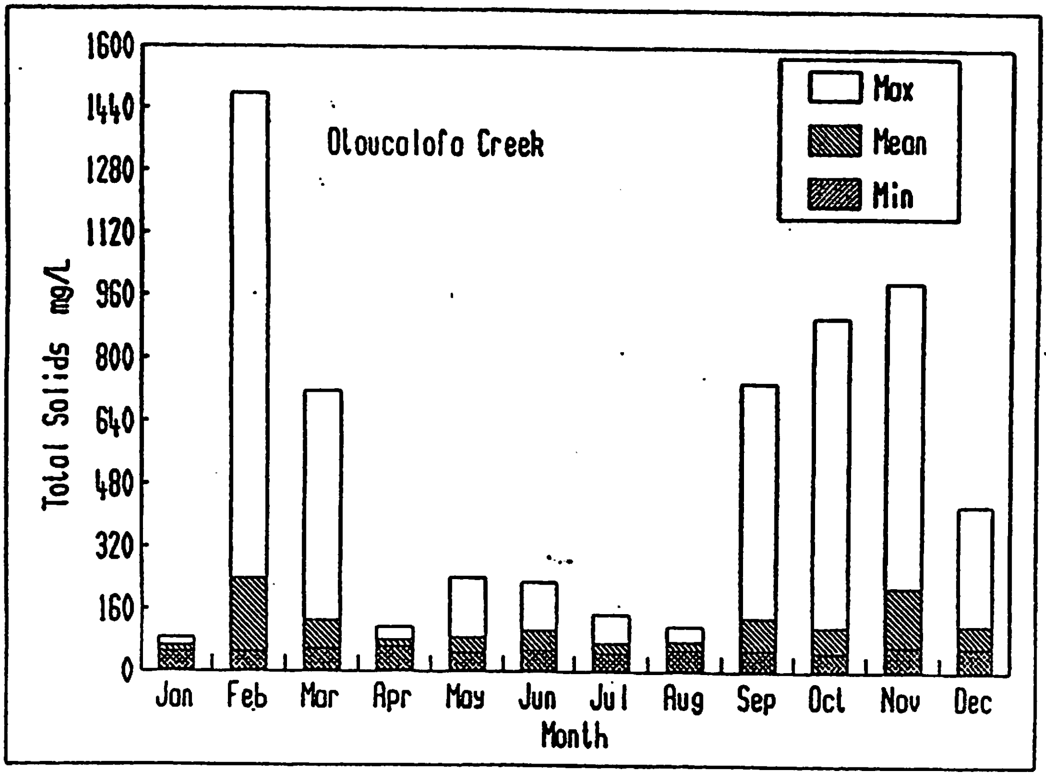
Total Solids and Suspended Solids - Composition and concentration of total and suspended solids, which include both organic and inorganic materials, are determined by a combination of factors including soil type, vegetation, drainage pattern, and rainfall and runoff characteristics. Total solids and one of its major constituents, suspended solids, may effect aquatic organisms in several ways. Mechanical abrasion damages delicate organisms or delicate tissues of heartier organisms such as fishes' gills. As sediments settle out of suspension, the blanketing effect can kill sessile organisms, thus depleting food supplies for fish and may kill or damage fish eggs and larval fishes. The organic portion of total solids can also effect the chemical characteristics of water by contributing to oxygen depletion. Since the inorganic portion of total and suspended solids consists of large irregular shaped surfaces and carries electrostatic charges, these particles can act as carriers for toxic materials such as heavy metals (USEPA 1973).

Long and Otoucalofa Creeks had yearly mean total solids that were not significantly different from one another; however, Long Creek had a significantly higher(P>.001) yearly mean suspended solids concentration (Table 2.). Both Otoucalofa and Long Creeks exhibited significant temporal changes as expressed by monthly means for total and

Table 2. Yearly means of total, suspended and dissolved solids and their ranges (in parenthesis) for all DEC watersheds during 1986.

Creek	Parameter		
	Total mg/L	Suspended mg/L	Dissolved mg/L
Otoucalofa	122 (48 - 1479)	65 (0 - 1424)	57 (31 - 113)
Long	135 (9 - 2941)	73 (0 - 2898)	62 (9 - 232)
Batupan Bogue	131 (77 - 325)	49 (0 - 261)	81 (58 - 116)
Hotophia	873 (61 - 3291)	823 (15 - 3273)	50 (10 - 72)
Hickahala	399 (51 - 2019)	346 (0 - 1985)	53 (31 - 86)
Black	167 (82 - 742)	75 (0 - 687)	91 (55 - 153)

suspended solids. No seasonal pattern was evident in either stream (Figs. 17 and 18), but higher concentrations were always associated with rainfall runoff events. While



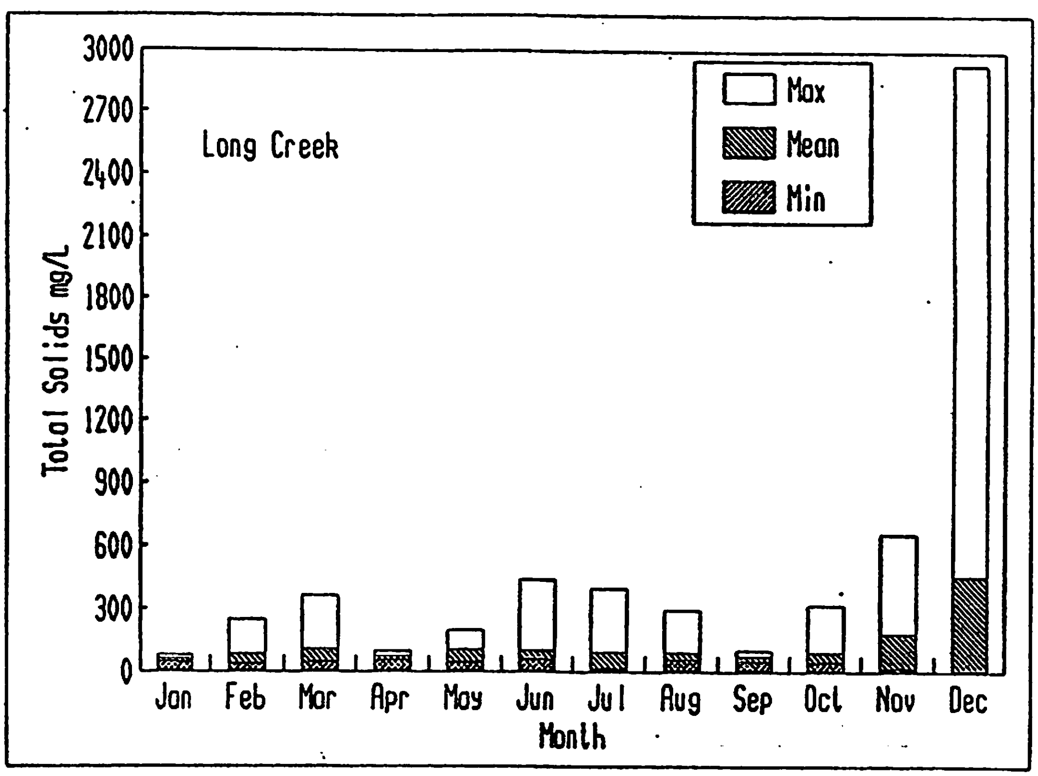
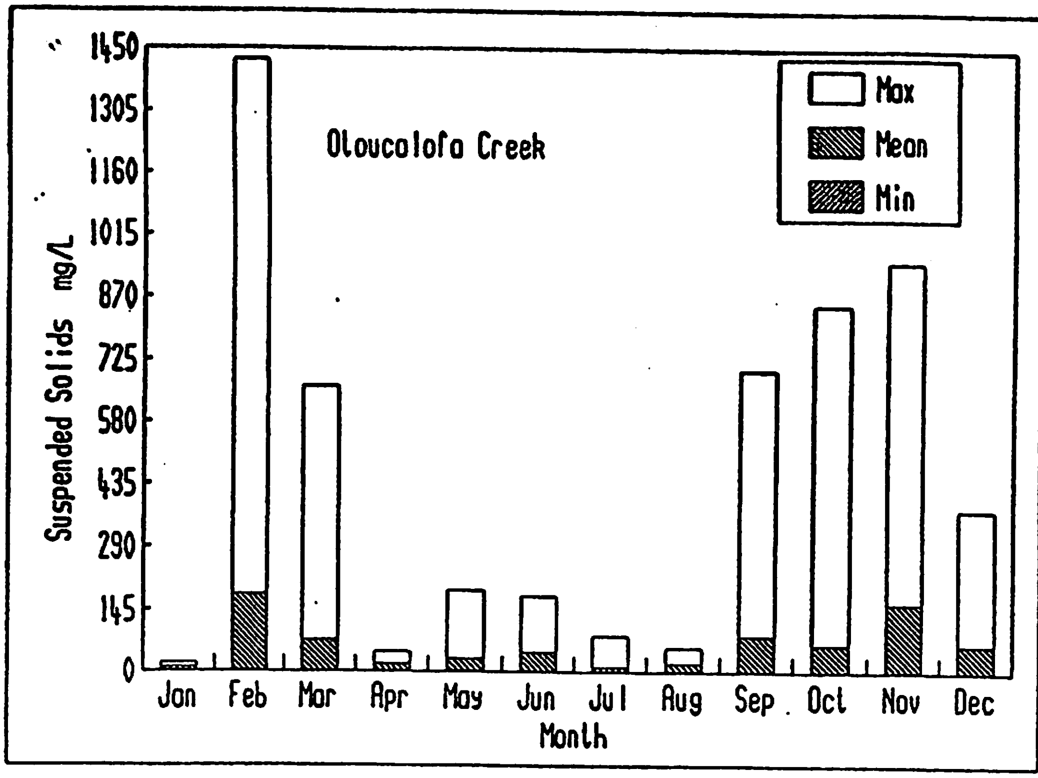


Figure 17. Monthly mean, maximum and minimum total solids for Otoucalofa and Long Creeks during 1986.



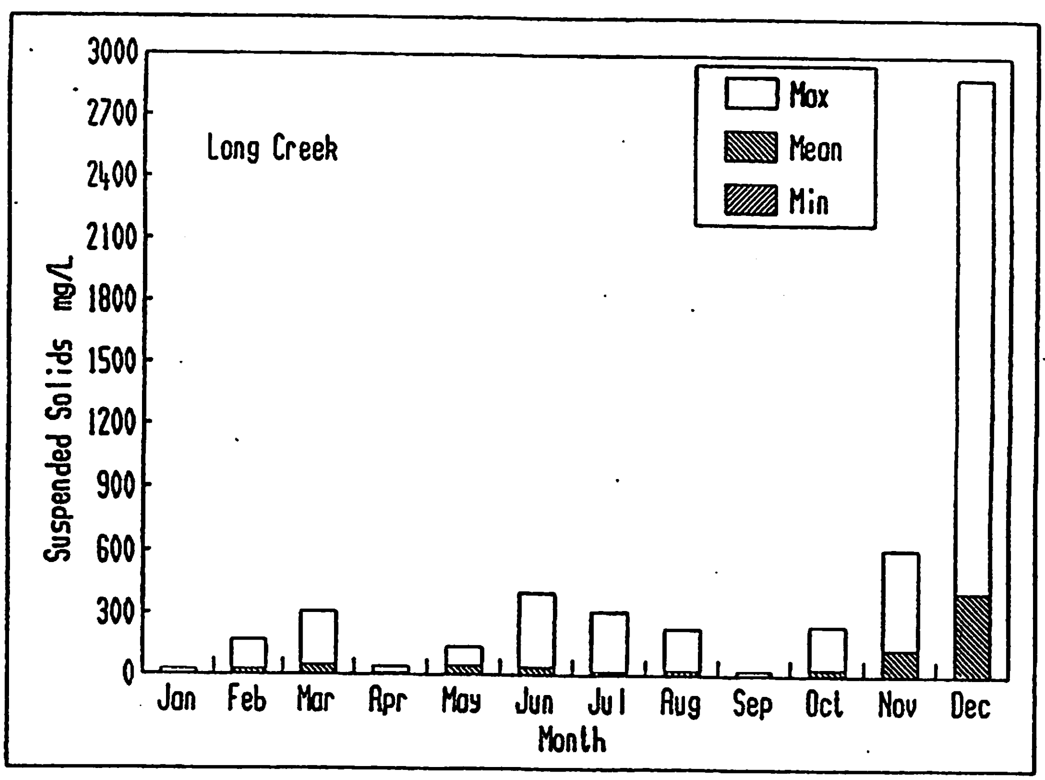


Figure 18. Monthly mean, maximum and minimum suspended solids for Otoucalofa and Long Creeks during 1986.

significant differences in site to site means of suspended solids were noted for both creeks, no differences were observed in site means of total solids.

No significant differences in yearly means, site means, or monthly means were observed for any of the streams sampled quarterly (Fig. 19 and 20).

Chemical Data

Nitrogen - Because of its high solubility in water, nitrogen, although necessary for all life, is not usually limiting in freshwater. Nitrogen, generally measured in water as ammonium-nitrogen or nitrate-nitrogen may enter an aquatic system via rainfall, air-water interface, runoff or as a waste product. Nitrate-nitrogen and ammonium-nitrogen are usually not considered toxic to most aquatic organisms (Hunnan et al. 1981), but they may contribute to increased production of phytoplankton which may eventually lead to an oxygen depletion.

Although Long Creek's nitrogen compounds exhibited greater variability than those from Otoucalofa Creek (Figs. 21 and 22), Otoucalofa Creek had significantly higher yearly mean levels of nitrate-nitrogen and ammonium-nitrogen than Long Creek (Table 3). No significant month to month differences were observed for Otoucalofa Creek, but Long Creek had

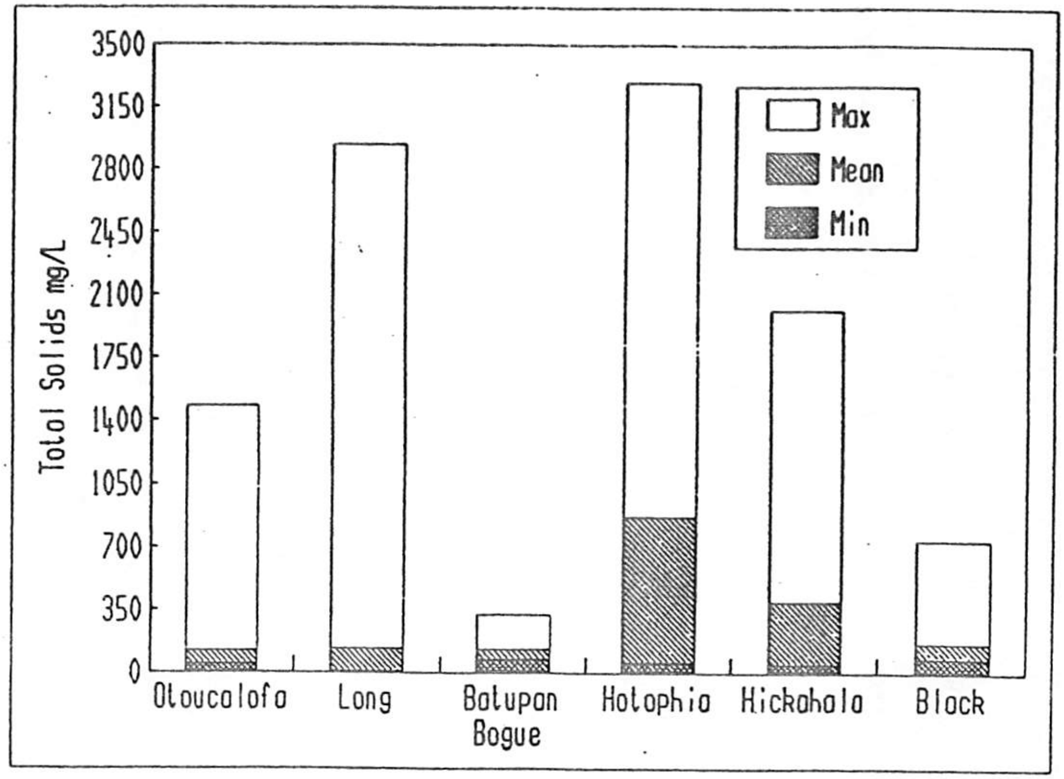


Figure 19. Yearly mean, maximum and minimum total solids for all DEC watersheds during 1986.

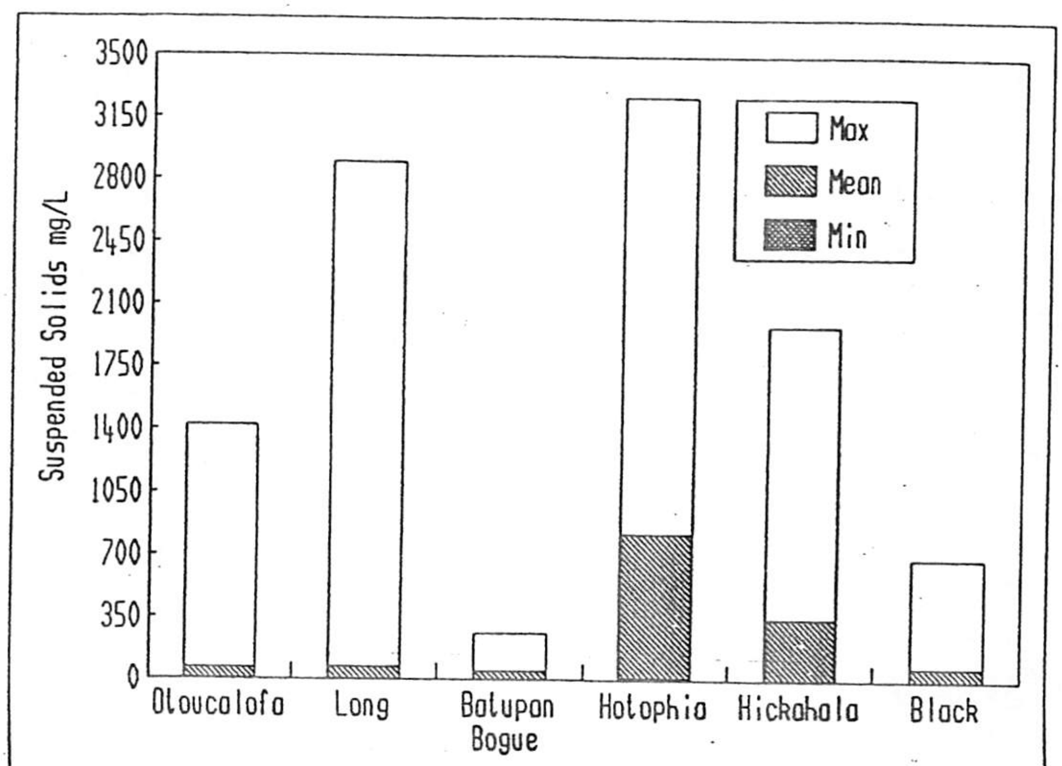


Figure 20. Yearly mean, maximum and minimum suspended solids for all DEC watersheds during 1986.

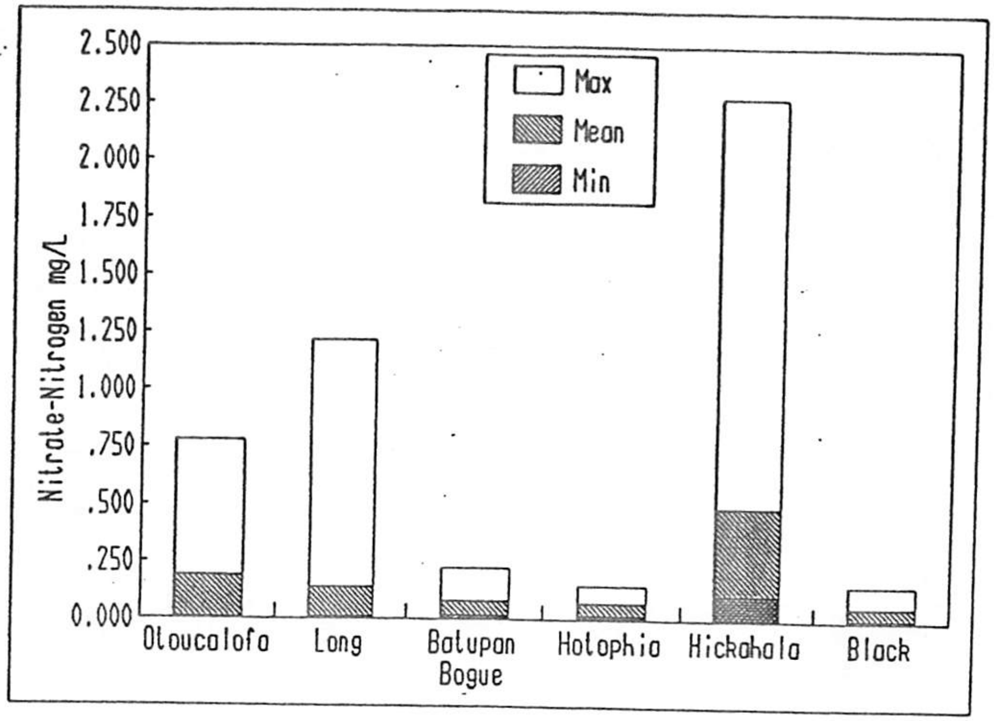


Figure 21. Yearly mean, maximum and minimum nitrate nitrogen for all DEC watersheds during 1986.

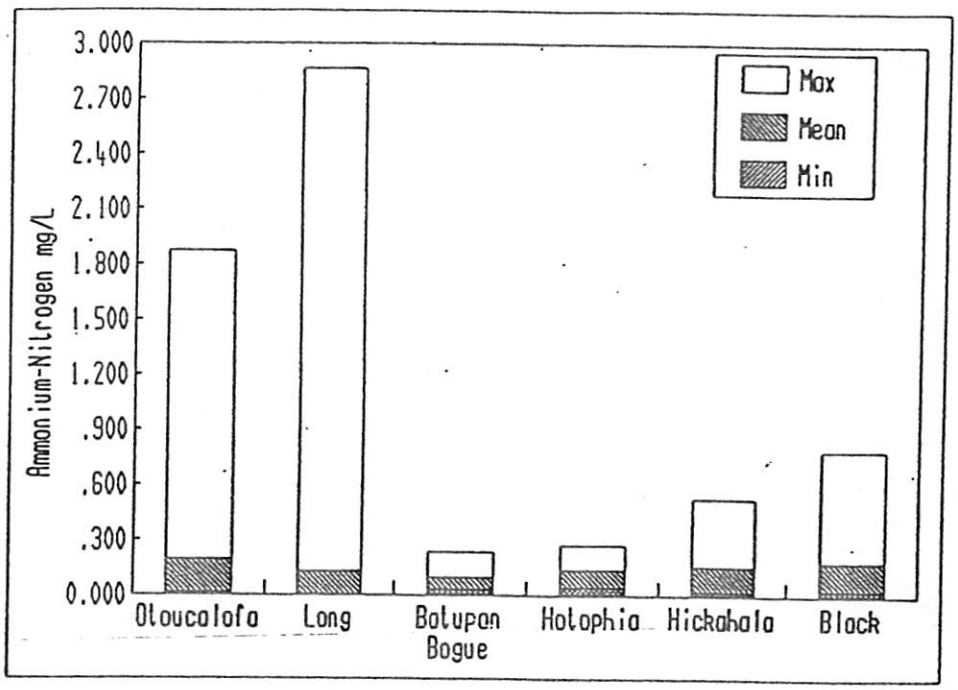
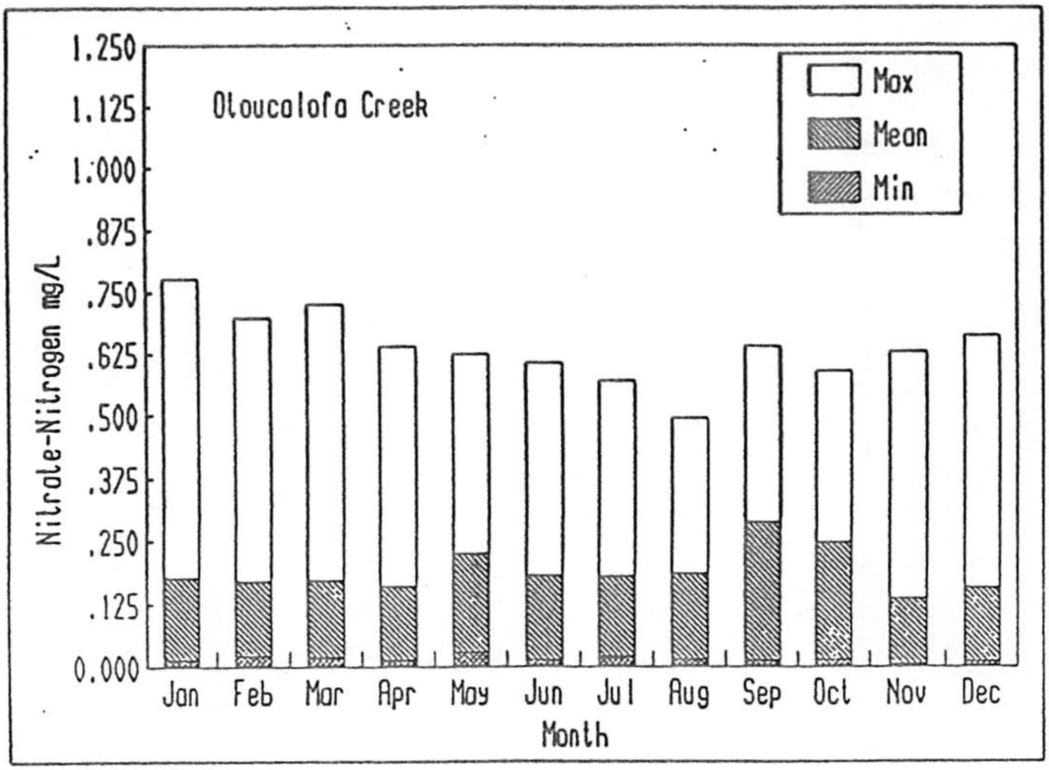


Figure 22. Yearly mean, maximum and minimum ammonium nitrogen for all DEC watersheds during 1986.

significantly higher monthly means of both nitrate- and ammonium-nitrogen in April and May, and in December for nitrate-nitrogen (Figs. 23 and 24). The spring increases coincided with fertilizer application and rainfall runoff. Otoucalofa Creek's nitrogen nutrients were relatively high and constant because of a point source input from a sewage treatment facility south of Water Valley, MS.

Table 3. Yearly means of nitrogen compounds and their ranges (in parenthesis) for all DEC watersheds during 1986.

Creek	Parameter	
	Nitrate-Nitrogen mg/L	Ammonium-Nitrogen mg/L
Otoucalofa	0.19 (0.00 - 0.78)	0.19 (0.02 - 1.88)
Long	0.14 (0.01 - 1.22)	0.13 (0.00 - 2.87)
Batupan Bogue	0.08 (0.02 - 0.23)	0.10 (0.04 - 0.24)
Hotophia	0.07 (0.02 - 0.15)	0.14 (0.05 - 0.28)
Hickahala	0.50 (0.11 - 2.28)	0.16 (0.02 - 0.53)
Black	0.06 (0.01 - 0.16)	0.18 (0.04 - 0.79)



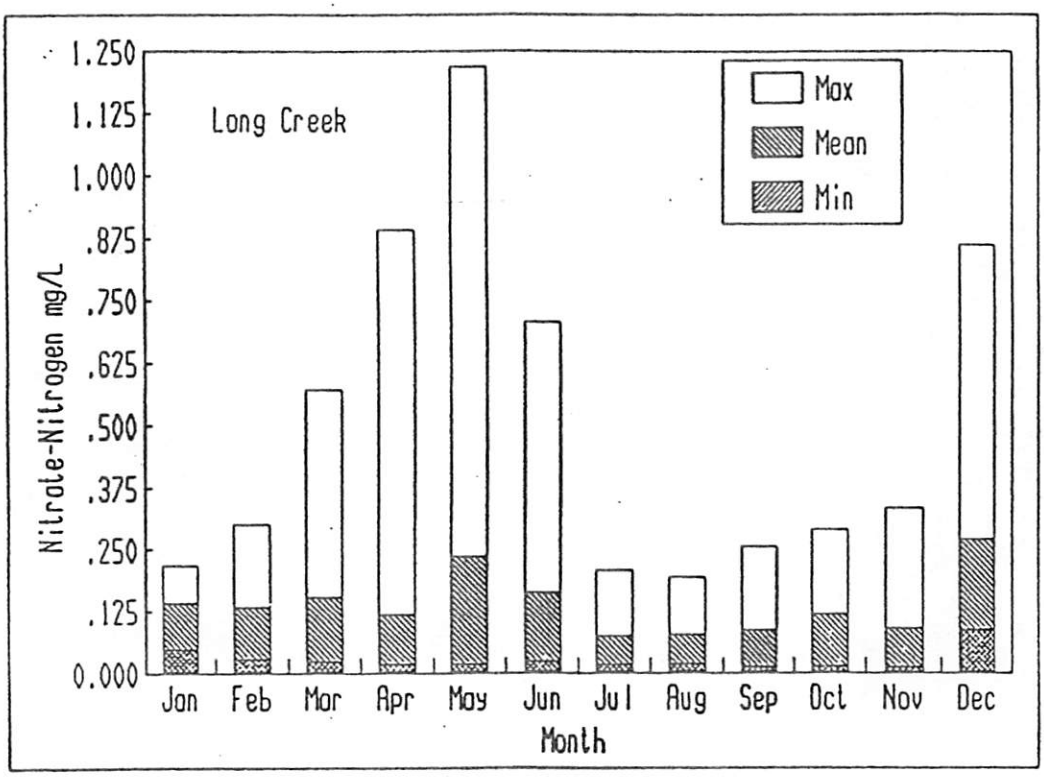
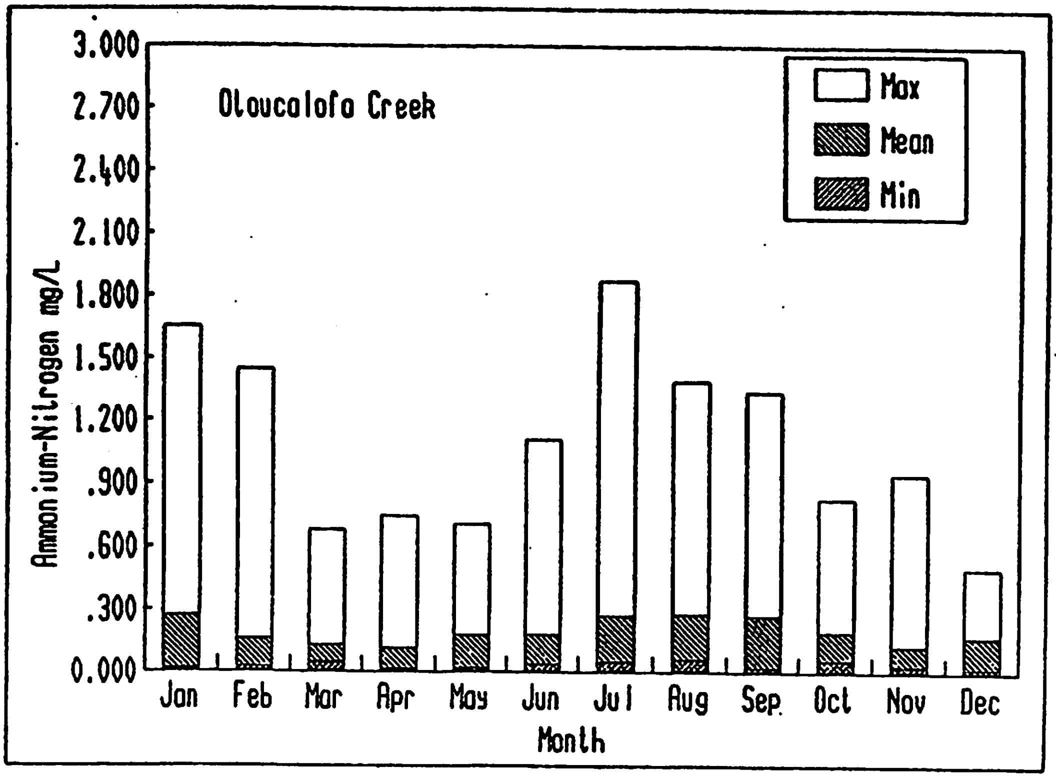


Figure 23. Monthly mean, maximum and minimum nitrate nitrogen for Otoucalofa and Long Creeks during 1986.



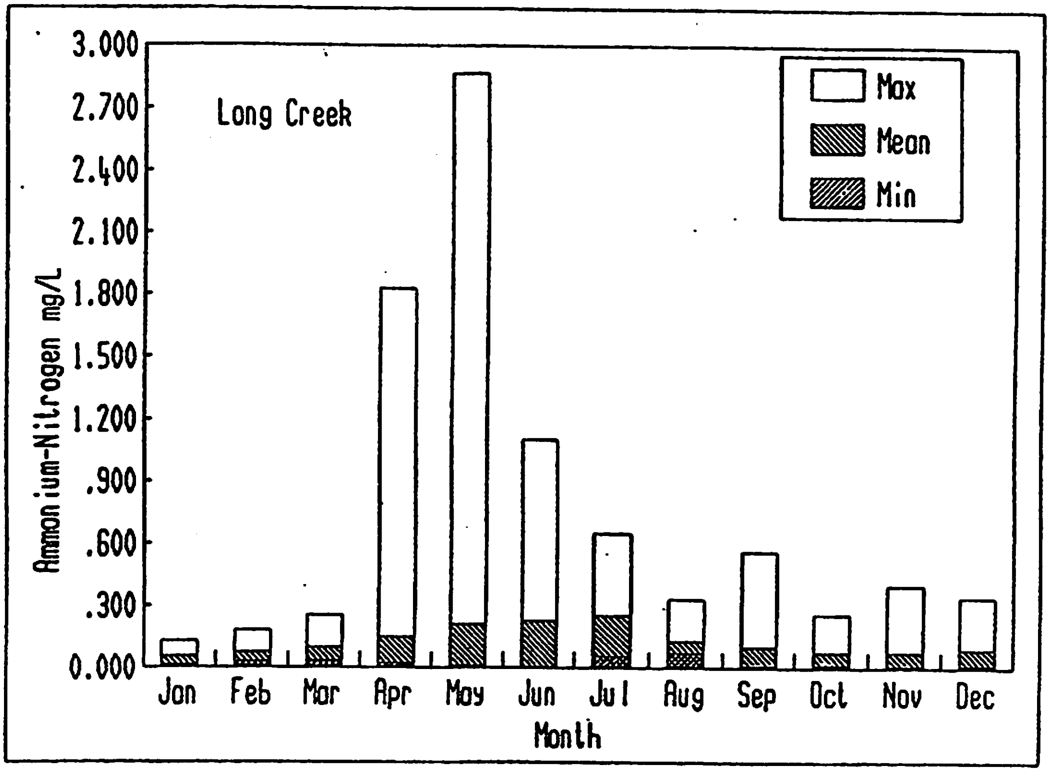


Figure 24. Monthly mean, maximum and minimum ammonium nitrogen for Otoucalofa and Long Creeks during 1986.

Site 1 on Otoucalofa Creek which is directly down stream of the sewage treatment lagoon had significantly higher nitrate-nitrogen and ammonium-nitrogen levels than all other sites (Fig. 4). Site 4 on Long Creek was significantly higher in nitrate-nitrogen than all other sites on that creek (Fig. 3), possibly because of the large area in pasture and rowcrop agriculture in the Johnson Creek subwatershed.

Hickahala Creek had a yearly mean nitrate-nitrogen level of 0.49 mg/L which was significantly higher than that of the other quarterly sampled streams (Fig. 1). In addition, site 8 on Hickahala Creek was the only site whose mean was significantly different ($P>.05$) from the other site means on any quarterly sampled watershed. Site 8 is located in a large pastured subwatershed on Senatobia Creek (Fig 1).

Phosphorus - Of all the "nutrient" compounds found in freshwater, phosphorus (P) compounds tend to be the most limiting because they have a low solubility and are rapidly absorbed by phytoplankton. Whereas nitrogen may be taken directly from the atmosphere, phosphorus must be leached from the soil and enter streams in runoff. Although excessive amounts of phosphorus compounds are rarely toxic, they do stimulate phytoplankton production and, therefore, can contribute to toxic algal blooms and resulting oxygen depletion.

Otoucalofa Creek had the highest yearly mean of filterable orthophosphorus of creeks sampled weekly. This phosphorus form was the only phosphorus containing nutrient to show a significantly higher (P>.001) yearly mean when one weekly sampled creek was compared to the other (Table 4).

Table 4. Yearly means of phosphorus forms and their ranges (in parenthesis) for all DEC watersheds during 1986.

Creek	Parameter			
	Filterable Ortho-P	Total Ortho-P	Hydrolyzable P	Total P
	mg/L	mg/L	mg/L	mg/L
Otoucalofa	0.04 (0.00-0.50)	0.05 (0.00-0.58)	0.06 (0.01-0.45)	0.11 (0.02-0.95)
Long	0.02 (0.00-0.46)	0.04 (0.00-0.53)	0.07 (0.01-1.13)	0.11 (0.02-1.55)
Batupan Bogue	0.01 (0.00-0.01)	0.02 (0.01-0.06)	0.06 (0.02-0.20)	0.08 (0.03-0.26)
Hotophia	0.01 (0.00-0.02)	0.10 (0.01-0.48)	0.25 (0.02-0.98)	0.35 (0.05-1.32)
Hickahala	0.03 (0.00-0.11)	0.11 (0.01-0.48)	0.24 (0.01-0.83)	0.35 (0.02-1.27)
Black	0.02 (0.00-0.08)	0.06 (0.02-0.17)	0.09 (0.02-0.54)	0.15 (0.05-0.70)

Site 1 on Otoucalofa Creek was significantly higher than any of the other sites on the stream for all phosphorus forms.

Site 4 on Long Creek had significantly higher concentrations of filterable orthophosphtes than other Long Creek tributaries. Otoucalofa Creek exhibited significantly higher total hydrolyzable phosphorus levels in the fall and winter months of September, October, November, and January (Figs. 25). No significant monthly differences were observed for the other measured compounds (Figs. 26, 27, and 28). On Long Creek, December had a significantly higher monthly mean of all phosphorus forms, with the exception of filterable orthophosphorus which was not significant (Figs. 25, 26, 27, and 28).

Of the streams sampled quarterly Batupan Bogue, had a significantly higher concentration of total phosphorus and total hydrolyzable phosphorus than the other streams (Figs. 29, and 30). No significant site to site differences were observed for any quarterly sampled creeks (Figs. 31 and 32).

Since all levels were relatively low, no detrimental impacts on aquatic organisms were observed in any of the DEC watersheds. The only detectable effects of nutrients in any of the streams occurred on Otoucalofa Creek above site 1 and down-stream from the sewage treatment facility at the mouth of Town Creek (Fig 4). In this area, large schools of gizzard shad (Dorosoma cepedianum), a common forage fish, were observed feeding in plankton rich waters. Largemouth

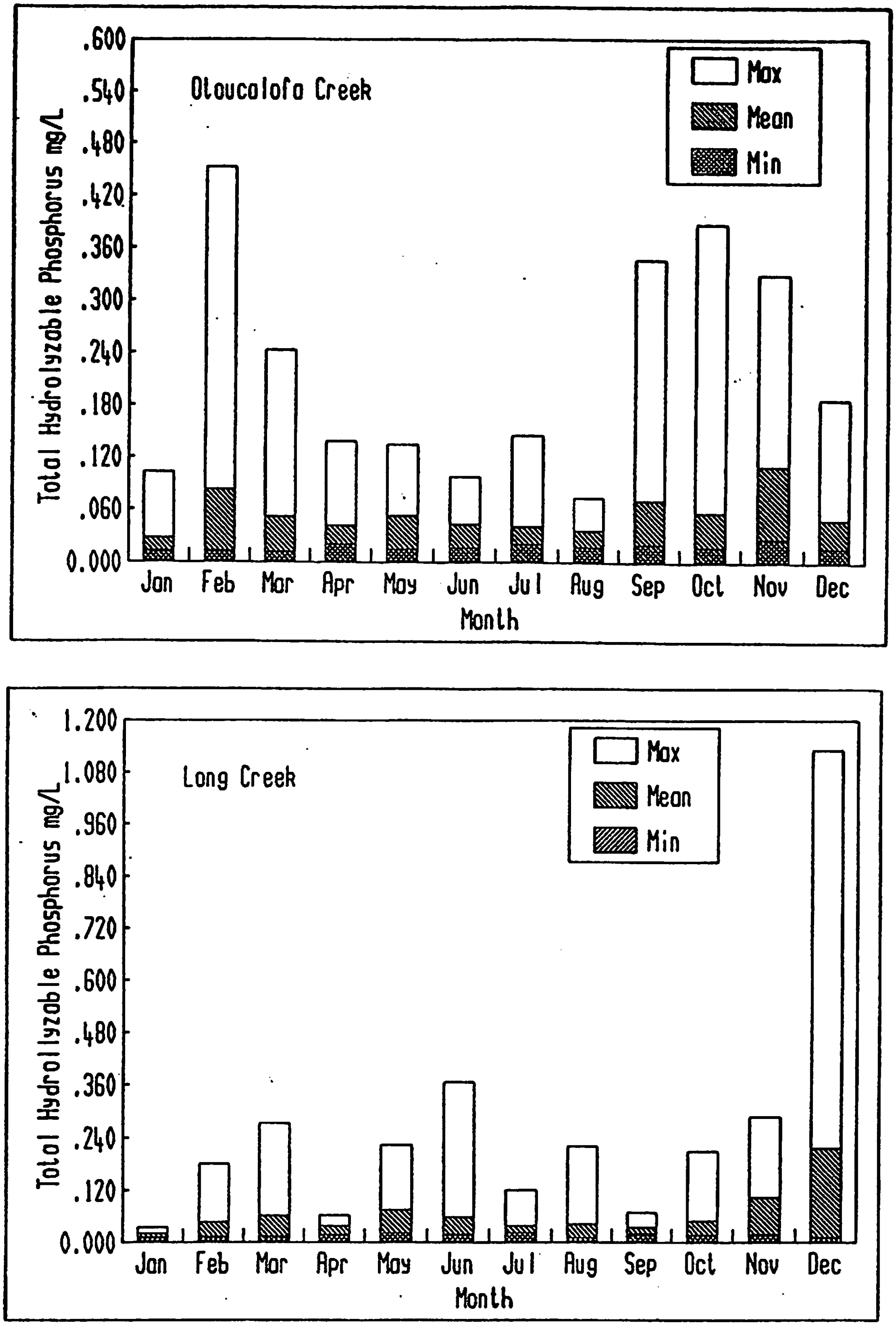


Figure 25. Monthly mean, maximum and minimum total hydrolyzable phosphorus for Otoucalofa and Long Creeks during 1986.

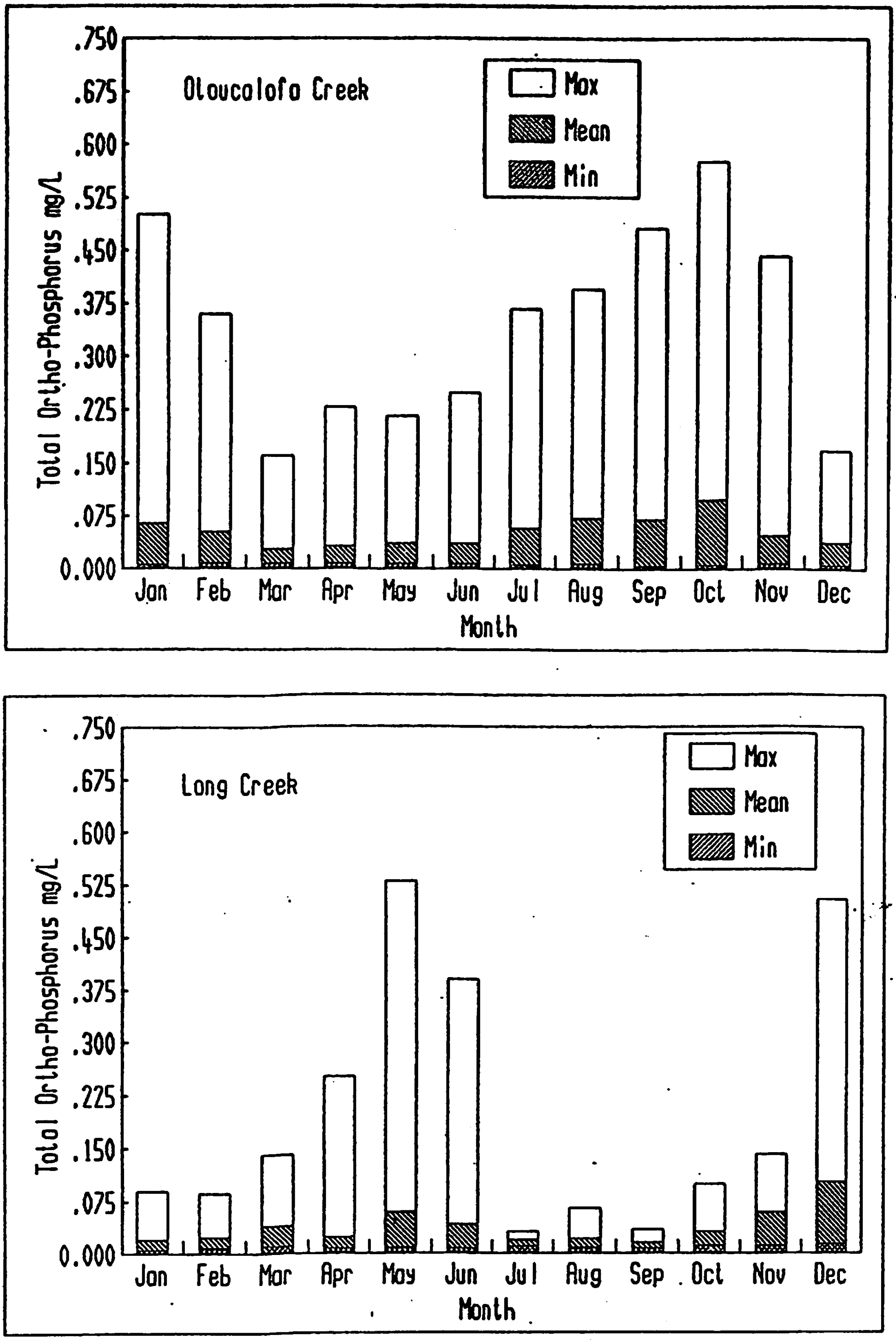
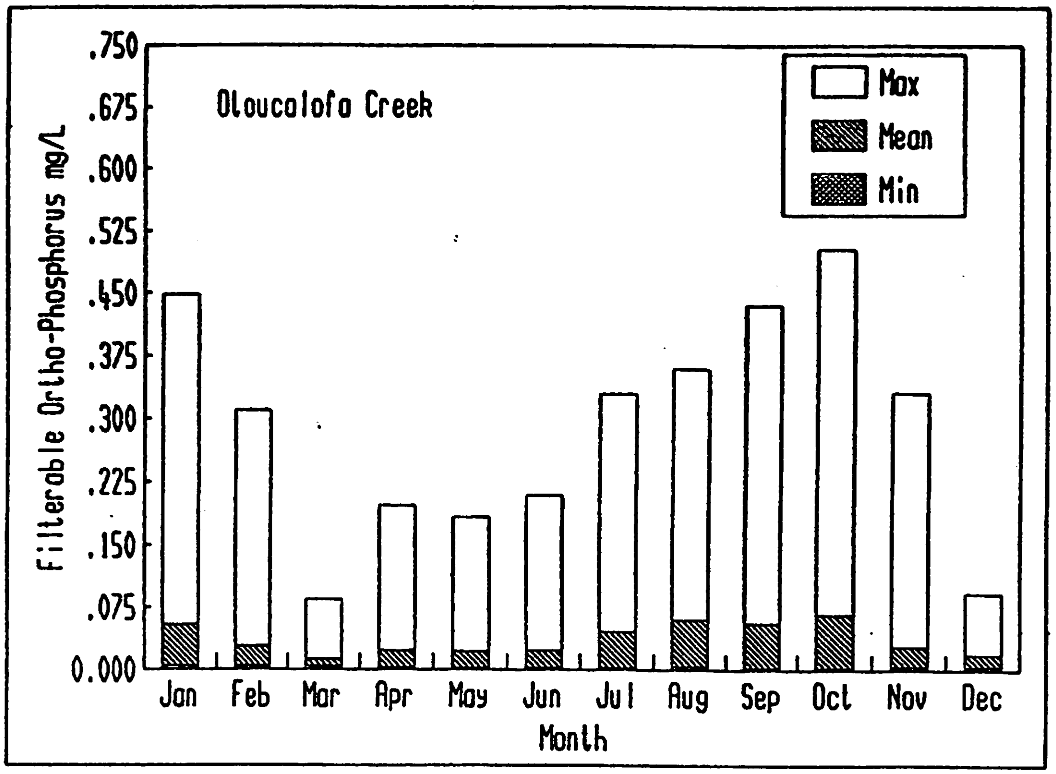


Figure 26. Monthly mean, maximum and minimum total orthophosphorus for Otoucalofa and Long Creeks during 1986.



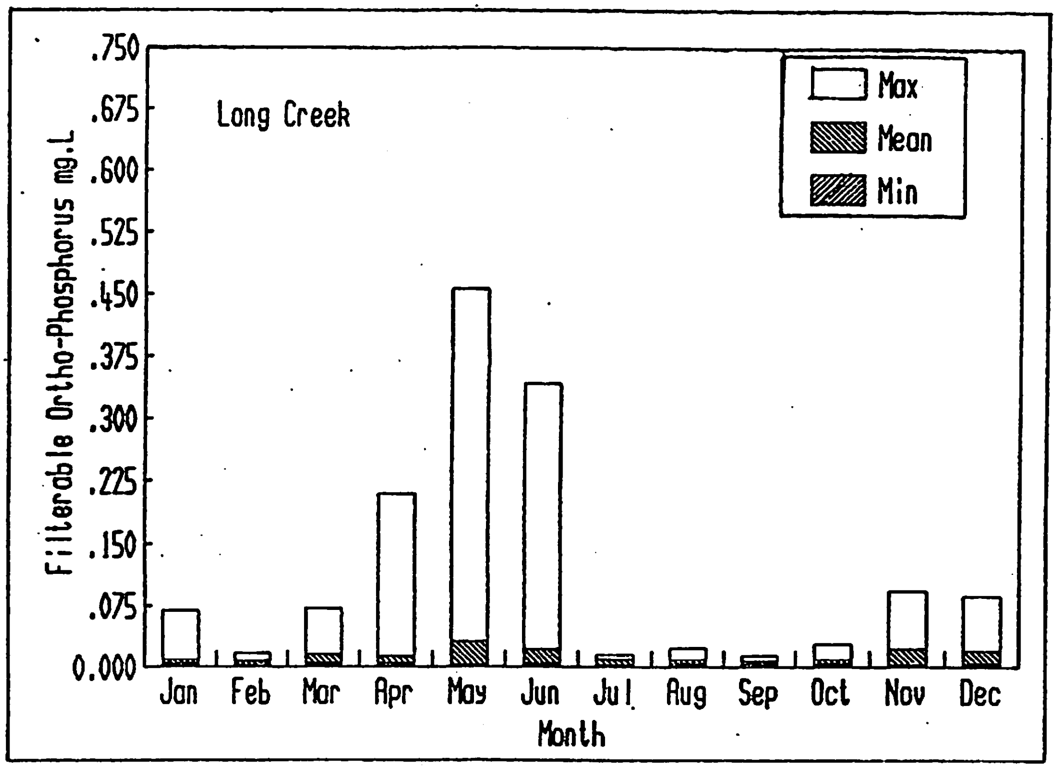


Figure 27. Monthly mean, maximum and minimum filterable orthophosphorus for Otoucalofa and Long Creeks during 1986.

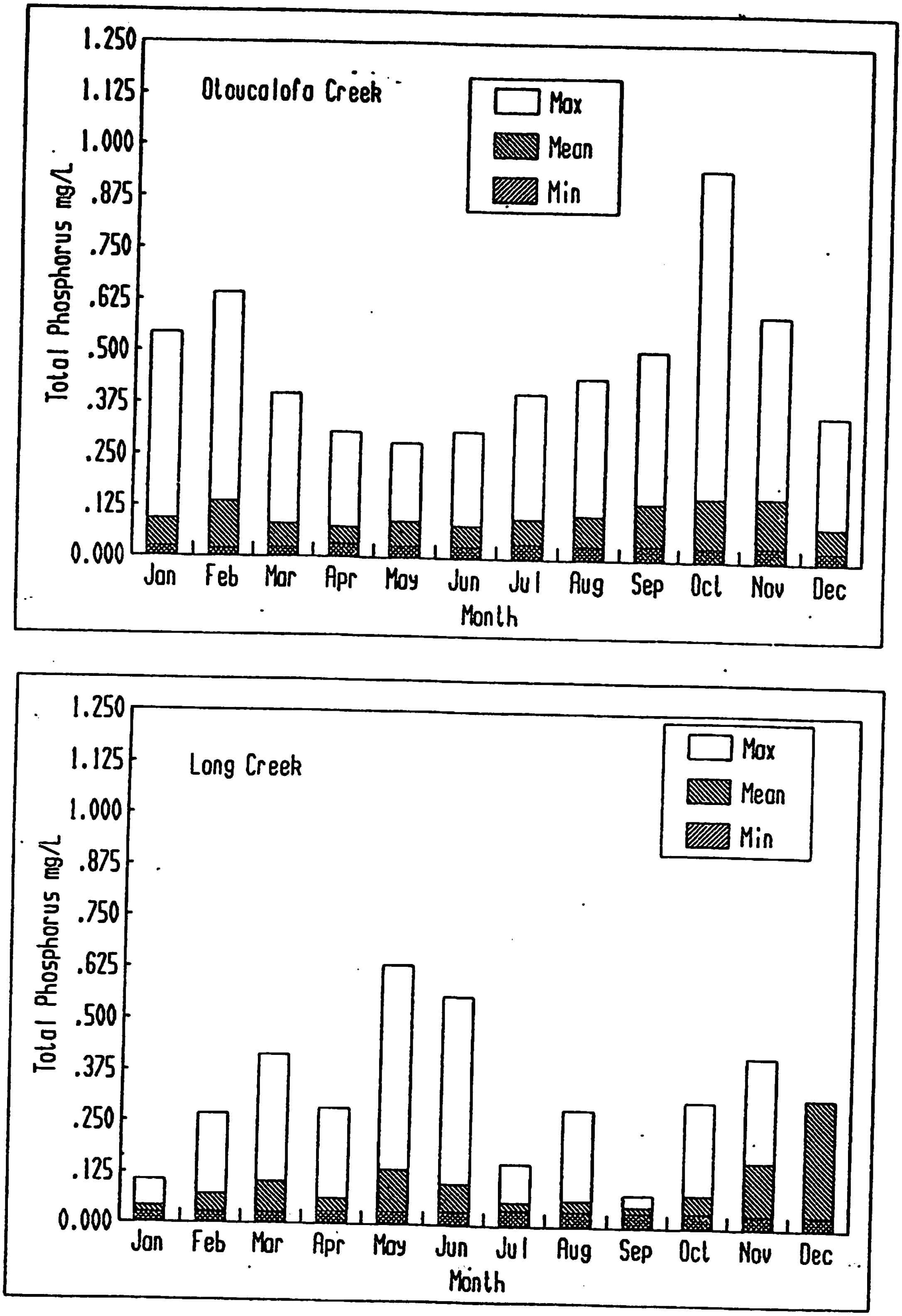


Figure 28. Monthly mean, maximum and minimum total phosphorus for Otoucalofa and Long Creeks during 1986.

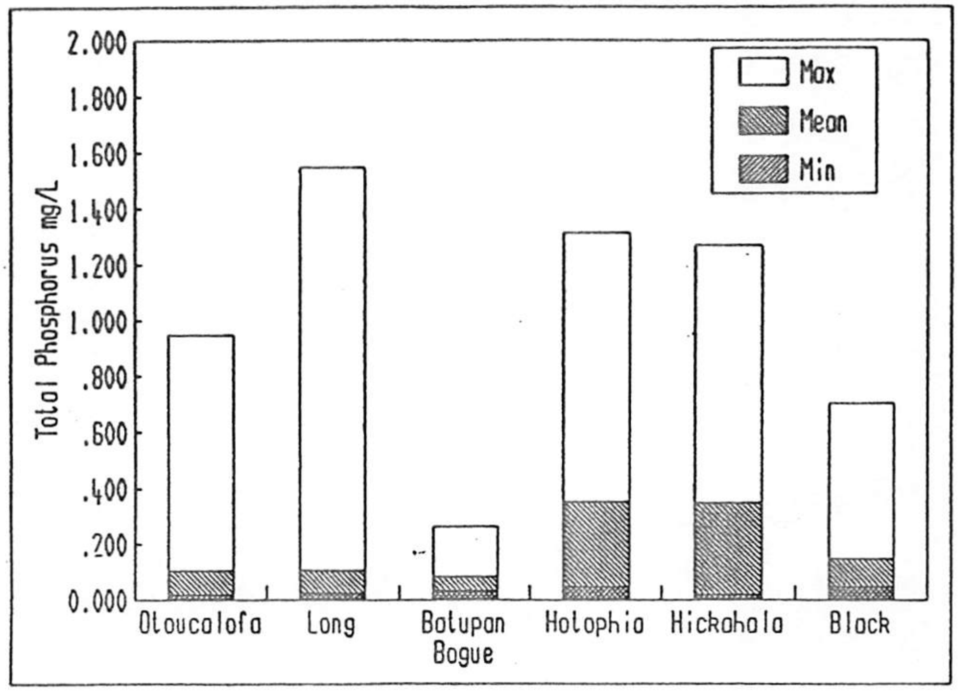


Figure 29. Yearly mean, maximum and minimum total phosphorus for all DEC watersheds during 1986.

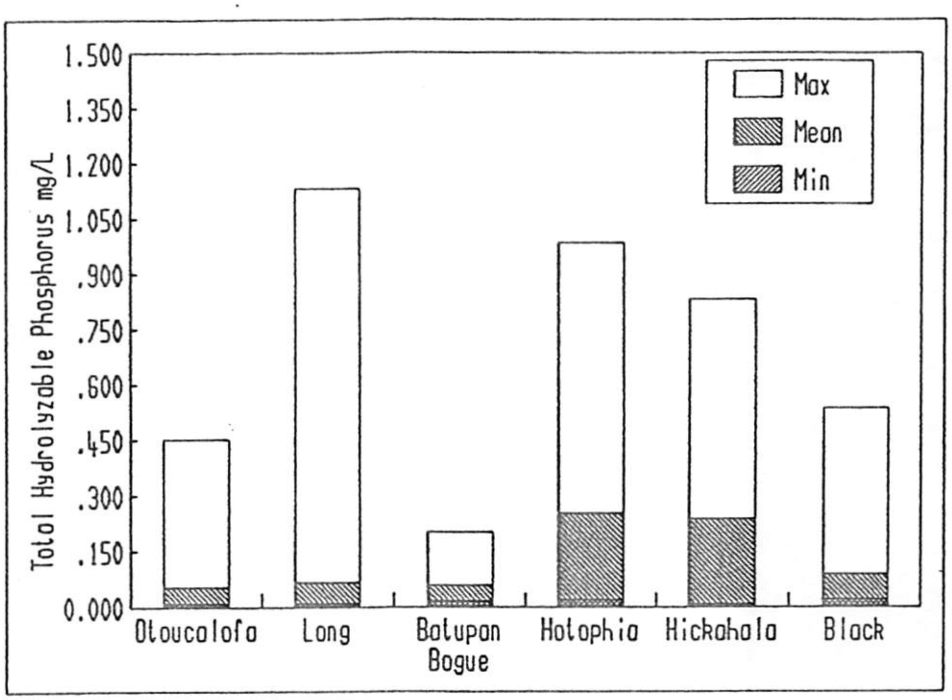


Figure 30. Yearly mean, maximum and minimum total hydrolyzable phosphorus for all DEC watersheds Creeks during 1986.

(*Micropterus salmoides*) and spotted bass (*Micropterus punctulatus*), which were apparently attracted to this large number of forage fishes, were collected at 5 times the normal catch per unit of effort for Otoucalofa Creek (Hammond 1970, Knight and Cooper 1987).

Biological Data

Coliform Bacteria - Bacterial coliform counts provide an index of "clean water" and are, therefore, important in determining if a body of water is suitable for recreation. Total coliforms provide only crude estimates for bacterial contamination and gives no information on possible sources of contaminants. A better measure is obtained from the ratios of fecal coliform to fecal streptococci where ratios above 4 indicate domestic sewage.

No significant differences were found between Long and Otoucalofa Creek's yearly means of total coliform, fecal streptococci or fecal coliform counts (Fig. 33). Further, no site to site differences were observed for either creek for any bacteriological parameter. Significantly higher numbers of all indicator bacteria were observed in December for both creeks (figs. 34, 35, and 36), probably resulting from rainfall related flush after several months of low flow conditions. The effects of rainfall on

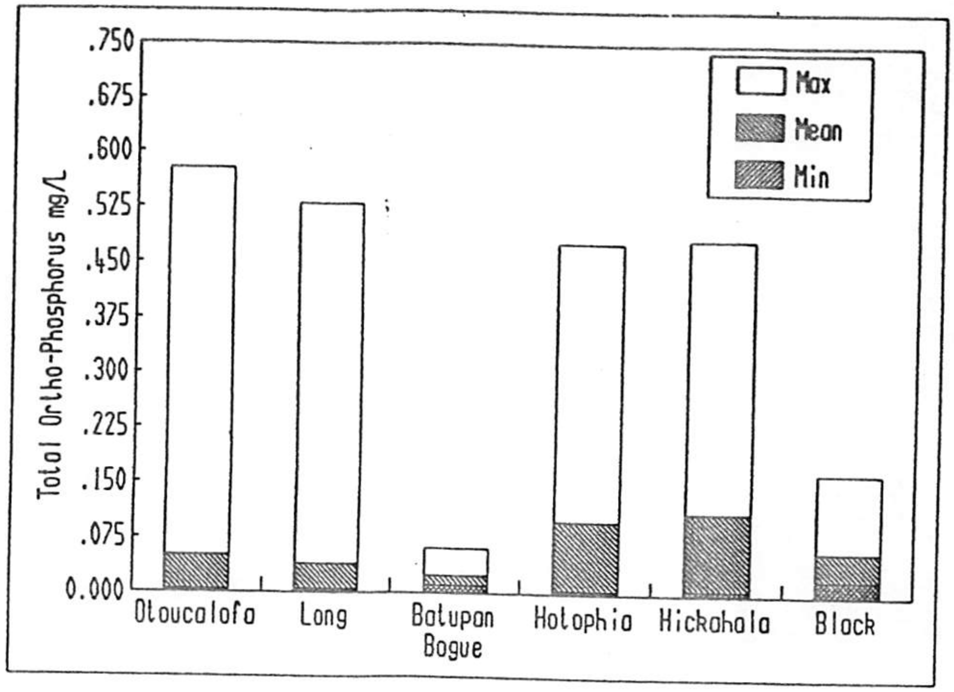


Figure 31. Yearly mean, maximum and minimum total orthophosphorus for all DEC watersheds during 1986.

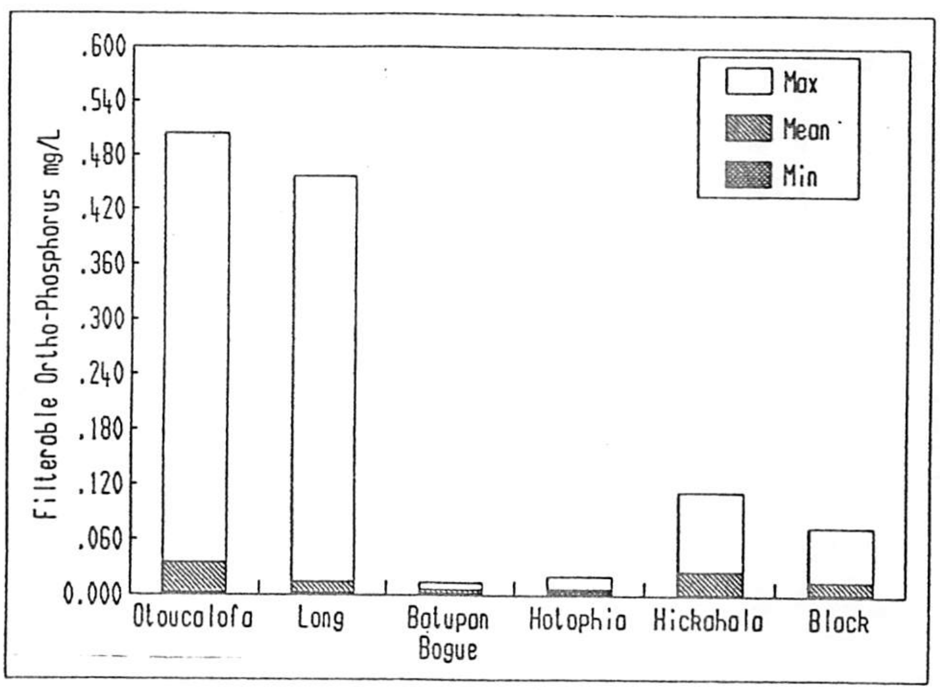


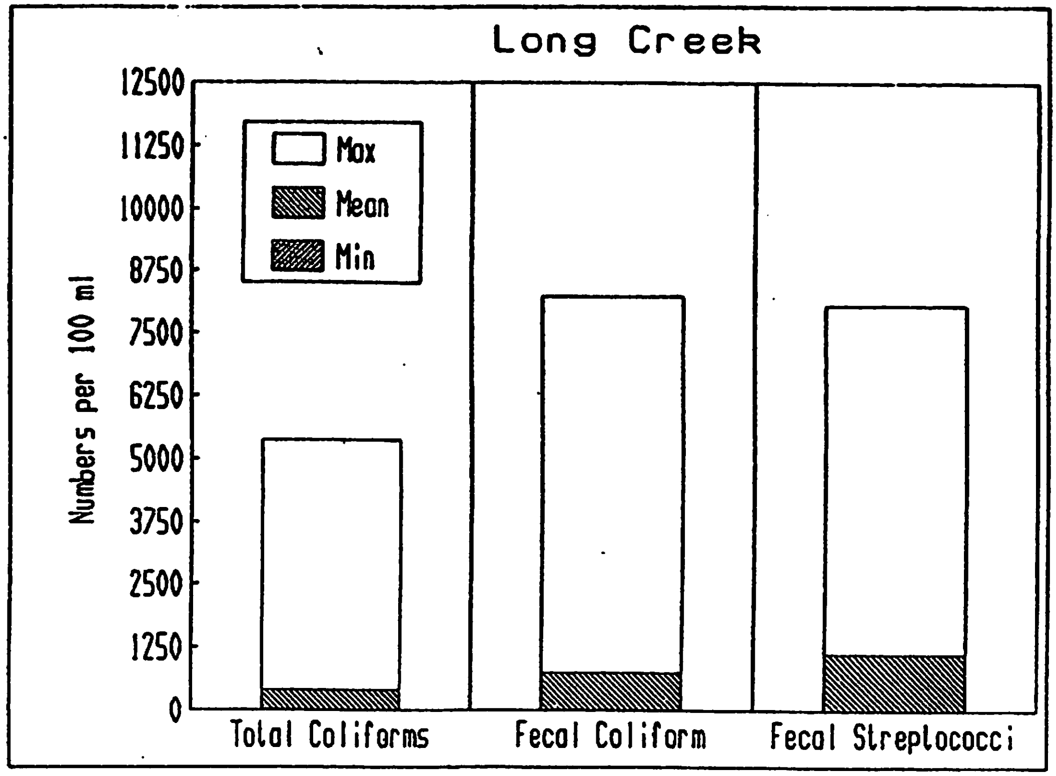
Figure 32. Yearly mean, maximum and minimum filterable orthophosphorus for all DEC creeks during 1986.

various parameters will be discussed in a more comprehensive pre-project water quality report.

Ratios of fecal coliform to fecal streptococci exceeded 4 on 7 different occasions on Long Creek and 6 times on Otoucalofa Creek (Fig. 37) indicating human contamination. Since this comprises less than 5 % of the total number of samples, human contamination does not appear to be a substantial problem. Coliform concentrations from warm blooded animals that inhabit stream borders rendered the water in both creeks unsafe for drinking, however such concentrations are common in streams of the southeast.

Acknowledgments

The authors wish to thank Steve Corbin, Robert Holley and Terry Welch for technical assistance. This report was prepared as a part of research under the Technology Applications project (TAP), USDA Sedimentation Laboratory, Agricultural Research Service, Oxford, Mississippi in cooperation with the Demonstration Erosion Control Project in the Yazoo Basin (DEC). Cooperation on analysis of coliform bacteria by Dr. L. A. Knight, Jr. and his staff at the University of Mississippi Department of Biology was appreciated.



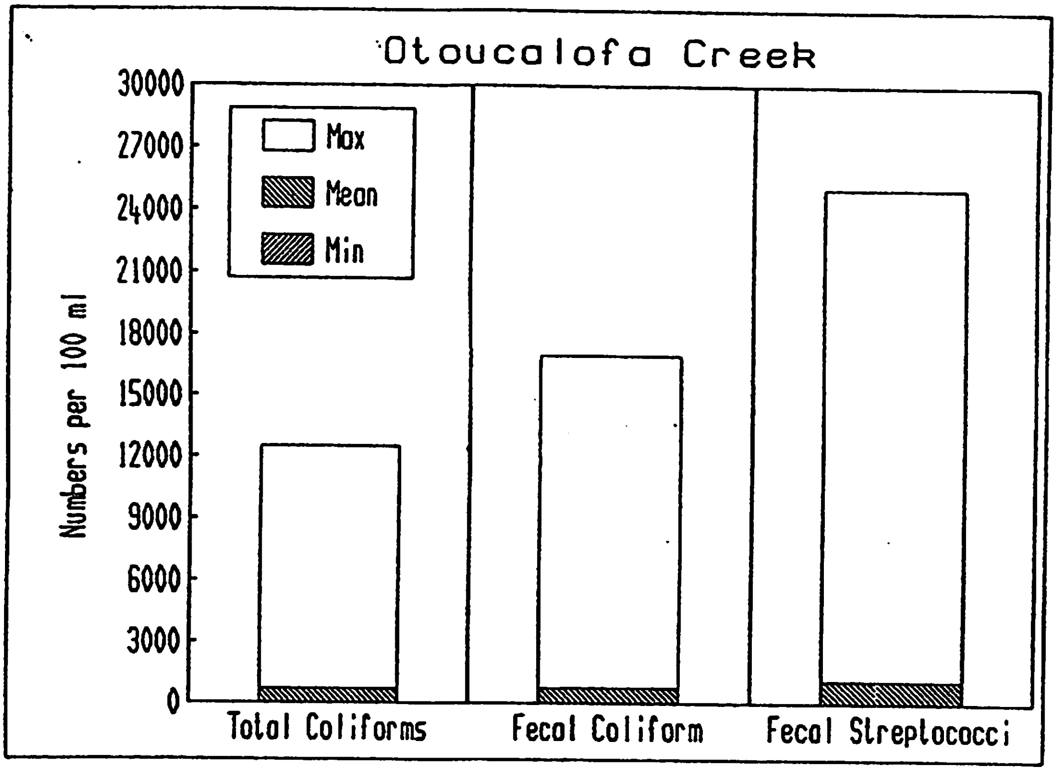


Figure 33. Yearly mean total coliform, fecal coliform and fecal streptococci counts for Long and Otoucalofa Creeks during 1986.

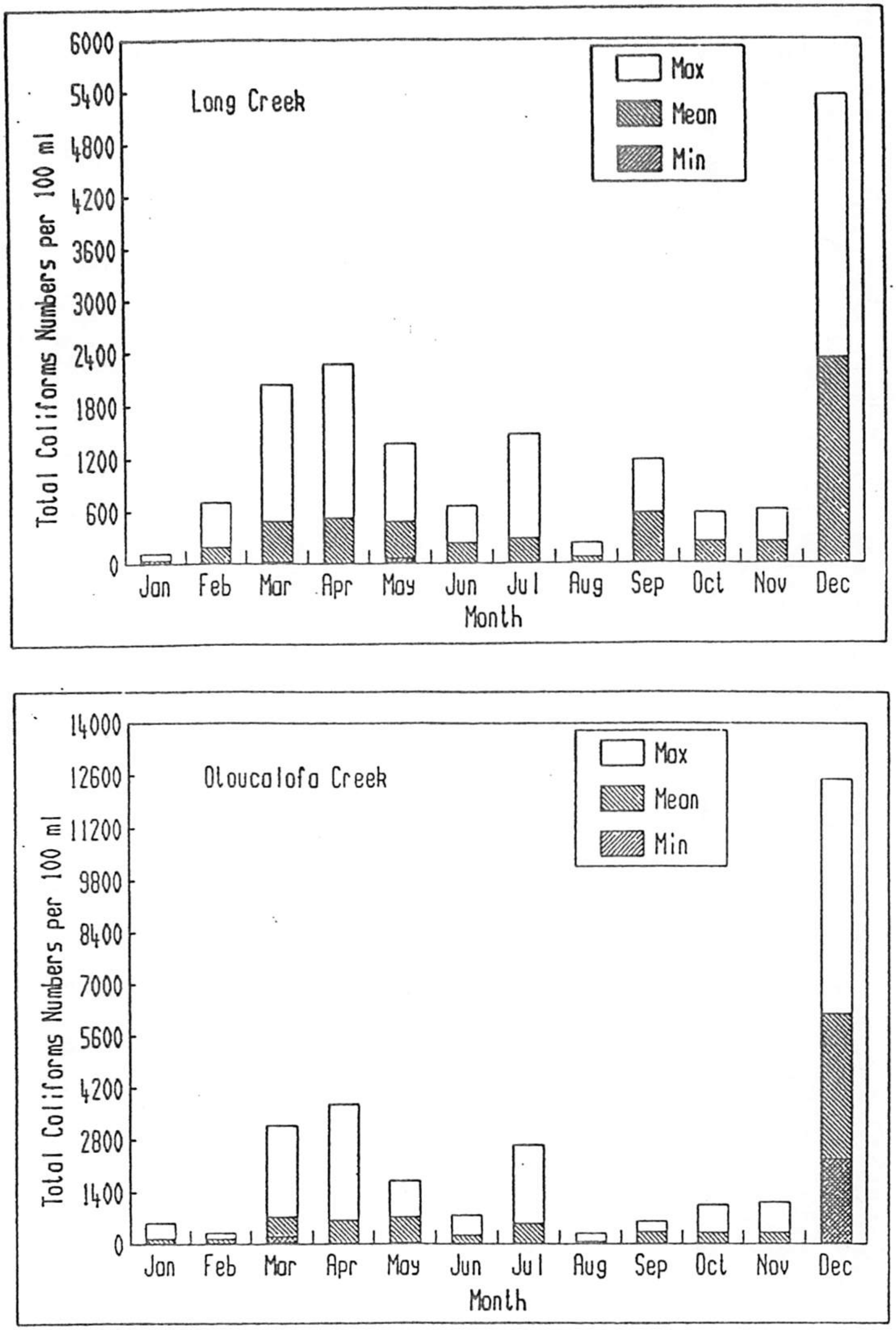
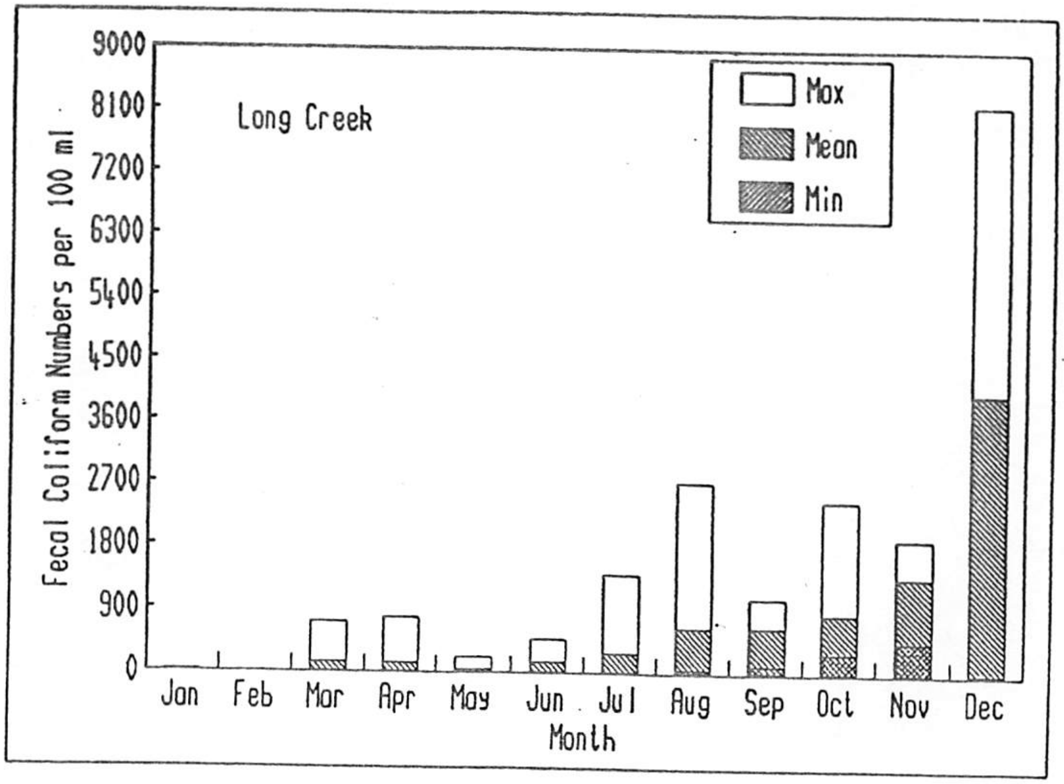


Figure 34. Monthly mean total coliform counts for Long and Otoucalofa Creeks during 1986.



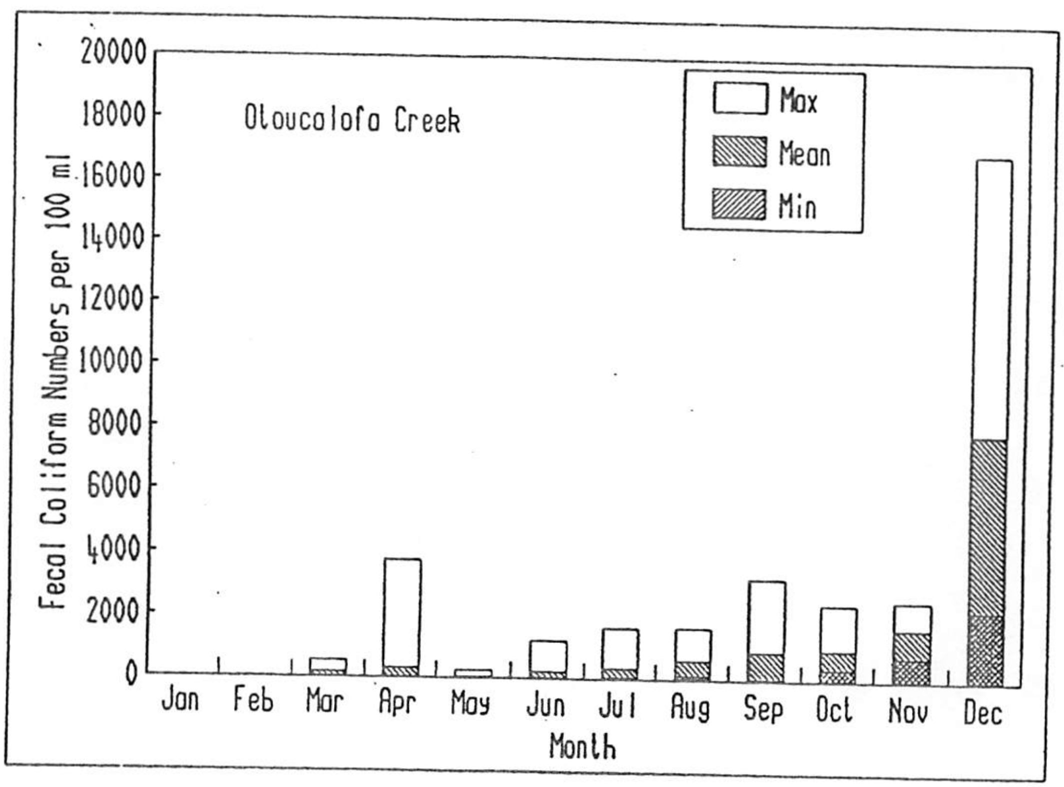


Figure 35. Monthly mean fecal coliform counts for Long and Otoucalofa Creeks during 1986.

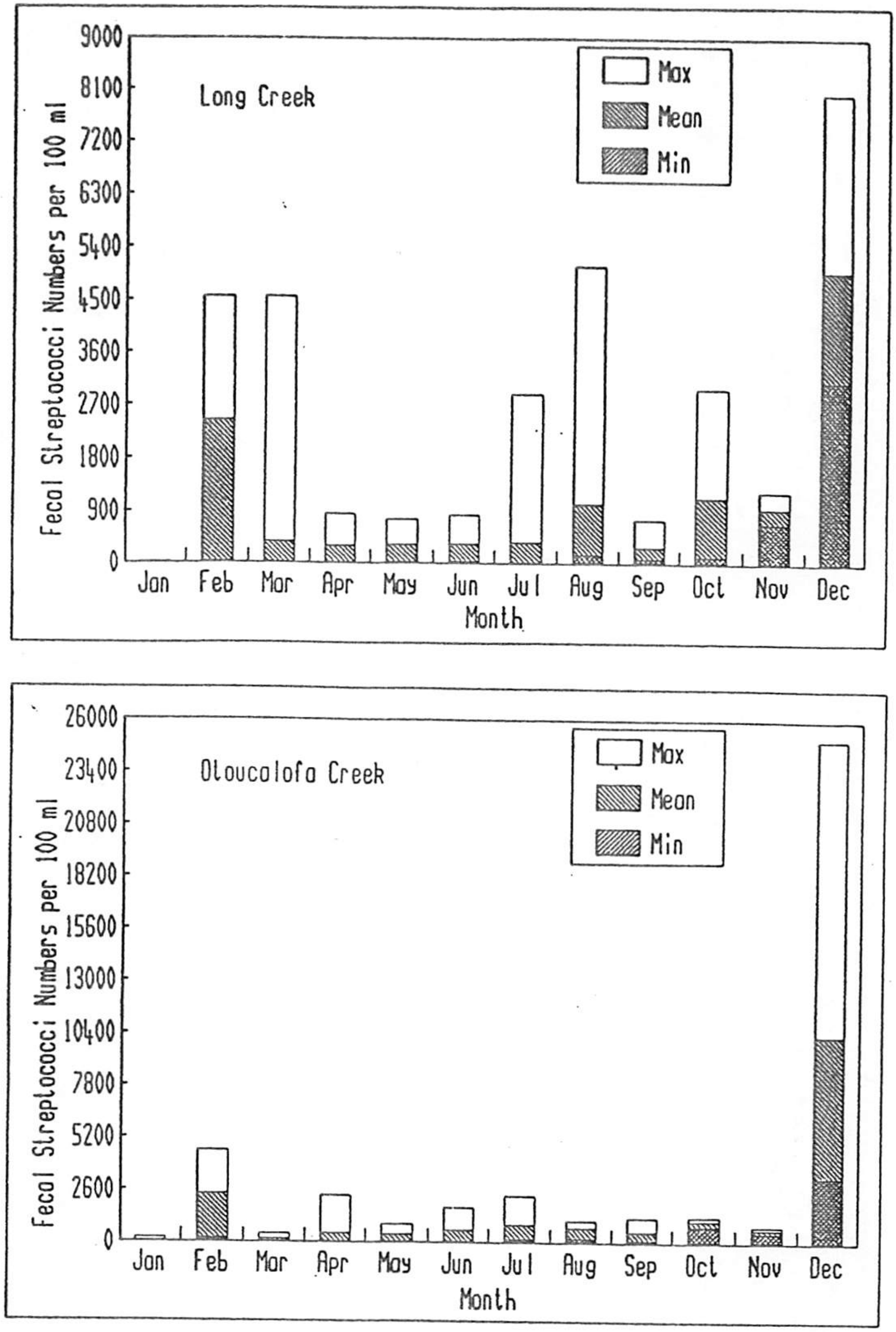


Figure 36. Monthly mean fecal streptococci counts for Long and Otoucalofa Creeks during 1986.

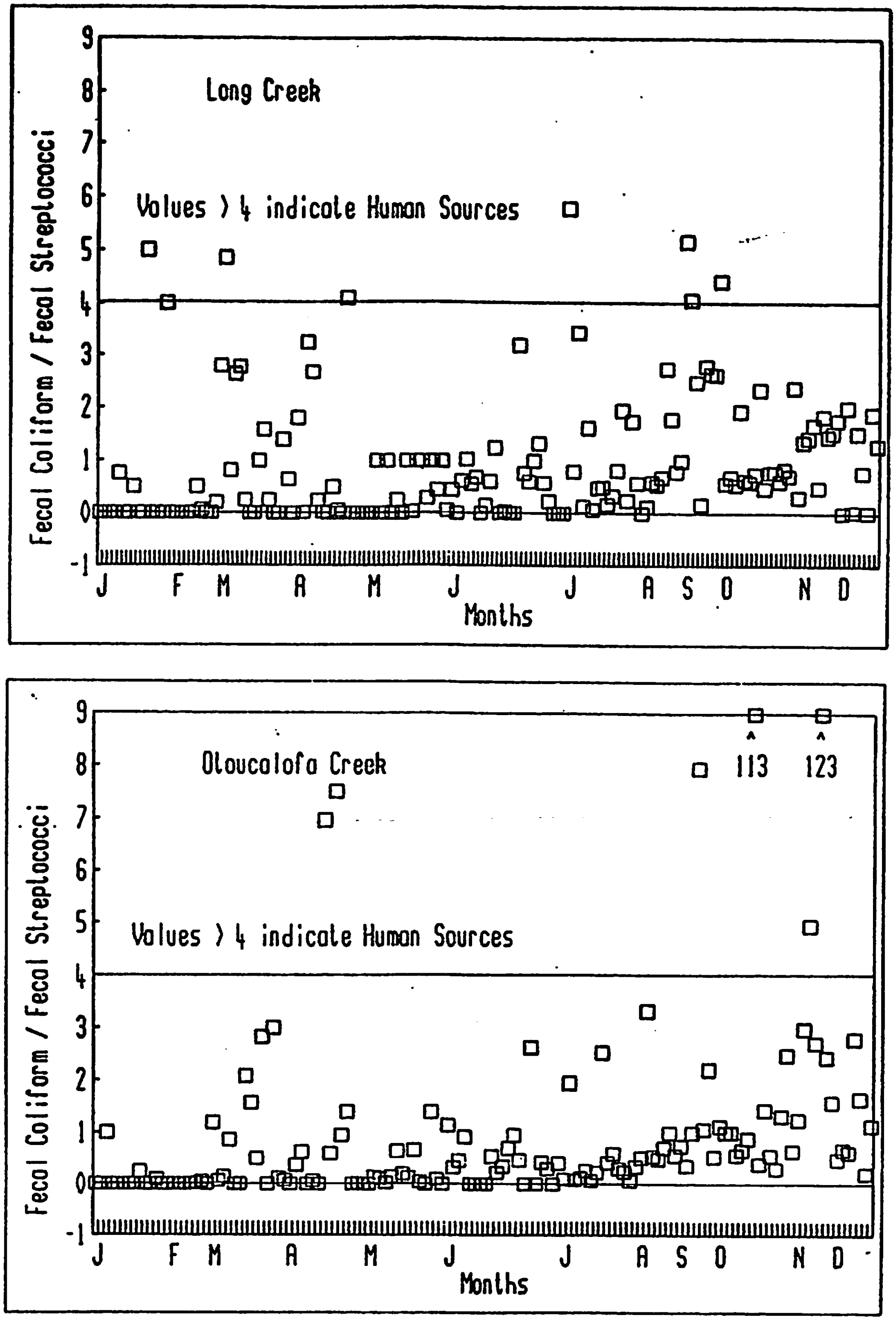


Figure 37. Ratios of fecal coliform to fecal streptococci counts for Long and Otoucalofa Creeks during 1986.

Literature Cited

American Public Health Association (APHA). 1975. Standard methods for the examination of water and wastewater 14th ed.: APHA, Washington, D. C., pp. 91-94, 908-926.

Cole, G. A. 1975. Textbook of Limnology. The C. V. Mosby Company, Saint Louis, MO. 283 pp.

Hammond, R. A. 1970. A study of fish fauna indegenous to three creeks in Yalobusha County, Mississippi. Unpub. M.S. Thesis, University of Mississippi, 56 pp.

Hart, W. B., P. Doudoroff and J. Greenbank. 1945. Evaluation of toxicity of industrial wastes, chemicals and other substances to freshwater fishes. Water Control Lab., Atlantic Refining Co., Philadelphia, PA. 30 pp.

Hunnan P., A. Milne and P. Stabbing. 1981. The living aquarium. Crescent Books. New York, NY. 240 pp.

Knight,S.S. and C. M. Cooper.1987. Pre-project water quality of Demonstration Erosion Control Watersheds during 1985. U.S.D.A. Agricultural Research Service, Technology Application Project Report #1, 46p. Available from: U.S.D.A. Sedimentation Lab, Oxford,MS.

Knight, S. S. and C. M. Cooper. 1987. Fishes of Otoucalofa Creek, Mississippi, prior to major channel stabilization modifications. J. Mississippi Acad. of Sciences 32:31-38.

Mace, H. H. 1953. Disposal of wastes from water treatment plants. Pub. Works 7:73-76.

Rousefell, G. A. and W. H. Everhart. 1953. Fisheries Science. It's Methods and Applications. John Wiley and Sons, Inc. New York, 444 pp.

U. S. Environmental Protection Agency. 1973. Water quality criteria. 1972. Washington, D. C. EPA-R-73-033. 594 pp.

U. S. Environmental Protection Agency. 1974. Methods for chemical analysis of water and wastewater. Methods Development and Quality Assurance Research Laboratory. Cincinnati, OH. EPA-6251 s-74-003. 298 pp.

Wedemeyer, G. A., F. P. Meyer, and L. Smith. 1976. Diseases of fishes. T.F.H. Publications, Neptune City, New Jersey. 192 pp.