

Job Report

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Project No. MF-R-6 Date September 29, 1965
 Project Name: Analysis of Populations of Sports and Commercial Fin-Fish and of Factors Which Affect these Populations in the Coastal Bays of Texas.
 Period Covered: January 1, 1964 to December 31, 1964 Job No. 12

Hydrographic and Meteorological Study of the Galveston Bay System

Abstract: Hydrographic data obtained in the field and climatological data taken from publications are presented in this report.

Salinities varied little from 1963 readings, but were higher than 1962 figures.

Trinity River discharge was 56 per cent less than that recorded in 1963.

Above average water and air temperatures occurred during November and December.

Objectives: To gather information on the hydrography and meteorology of Galveston Bay and to present this information in a report that will be convenient for use in this project and other projects.

Procedure: Water samples were taken monthly at 48 stations distributed throughout the Galveston Bay system (Figure 1). Water temperature and pertinent meteorological and physical data were recorded at each station. Salinities were determined by the Mohr titration method.

Supplementary data on salinities and water temperatures were obtained from the Bureau of Commercial Fisheries Biological Laboratory at Galveston, Texas.

Information on air temperatures, wind, and precipitation was taken from "Climatological Data, Texas", while river discharge data was obtained from the Water Resources Division of the U. S. Department of Interior, Geological Survey Branch.

Findings and

Discussion: Monthly salinity determinations of 48 stations sampled during 1964 are given in Table 1. Salinity patterns were similar to those recorded in 1963 and slightly higher than 1962 recordings (Figure 2). The greatest variation occurred in upper Galveston Bay, Trinity Bay, and East Bay which are under the influence of river discharge and drainage from rice fields. A reverse correlation between river discharge and salinity was apparent in these areas (Figures 2 and 3). Increased salinity in the fall was mainly attributed to high tides resulting from strong southeasterly winds and a drop in river discharge after June 1963 (Figure 3).

In 1964 the lowest discharge on the Trinity River (1.1 million acre-feet) since 1956 was recorded. Figure 4 shows river discharge of the Trinity River at Romayor, Texas for the period 1951 - 1964. River discharge was above average during 1957, 1958 and 1961. All other years received less than 5 million acre-feet of water per year.

Precipitation was slightly higher in 1964 than in 1962 and 1963, but did not approach the high levels of 1961 (Figure 5). Approximately 50 per cent of the total 1964 rainfall (38.9 inches) fell during July, August, and December following a somewhat dry spring.

No fish kills due to low temperatures were observed. Unusually warm air temperatures during November and December were recorded at the Galveston airport (Table 3). Water temperature data recorded at the Galveston Laboratory of the U. S. Bureau of Commercial Fisheries indicated above average water temperatures during this period. Water temperatures recorded at hydrographic stations are presented in Table 2. These readings show seasonal trends, but (because they are limited to one observation of each station per month) do not show maximum or minimum temperatures.

Prevailing "offshore" (NNE and NE) winds were recorded during January, February, October and December (Table 4). The prevailing winds were "onshore" (S, SE, and SSE) during other months. High tides associated with hurricane "Hilda" occurred during the first two weeks of October. Above normal tides also occurred during April and May.

Comments: Alteration of fishery habitat by a myriad of engineering projects brought about by the expanding economy of the Galveston Bay area has become a serious problem. An evaluation of the overall effects of such projects is needed.

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Literature Cited

U.S. Department of Commerce, Weather Bureau, 1961-1964. Climatological Data, Texas, Vol. 66, 67, 68, 69. National Weather Records Center, Ashville, N. C.

Table 1
Salinities - Galveston Bay Stations (1964)
(Expressed as Parts Per Thousand)

Station	January		February		March		April		May	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
SB	23.8	23.9	21.7	21.5	15.6	15.4	19.0	16.9	15.1	14.9
5MP	25.8	30.3	24.7	30.6	17.7	29.6	16.3	17.5	15.0	13.8
MP									12.2	12.6
UGB	21.6	21.7	18.5	18.4	11.4	11.3	13.2	13.8	13.1	13.1
MK	20.9	<u>21.2</u>	18.1	<u>18.1</u>	11.1	<u>11.1</u>	12.4	<u>12.4</u>	13.1	<u>13.3</u>
FS	16.6	<u>17.5</u>	18.4	<u>18.0</u>	11.2	<u>11.2</u>	8.7	<u>6.0</u>	13.3	<u>12.9</u>
UP	8.2	9.2	14.2	14.2	6.4	6.4	5.5	5.6		
AC	19.6	19.6	11.2	11.3	7.9	7.9	9.8	10.7	6.2	7.5
DB	21.2	21.2	8.0	7.9	11.1	11.3	13.7	13.6	8.4	9.5
LOB	21.8	21.8	12.9	17.1	11.9	11.9	14.2	14.1	9.3	10.2
TB	23.8	<u>23.9</u>	17.9	<u>18.0</u>	15.5	<u>16.0</u>	14.0	<u>14.1</u>	11.9	<u>12.8</u>
VI	20.7	21.0	14.2	<u>14.2</u>	12.2	13.2	15.8	16.0	10.0	10.5
SP	22.4	<u>22.4</u>	18.3	<u>18.4</u>	20.1	<u>20.8</u>	16.8	<u>17.1</u>	12.0	<u>13.3</u>
PAP	27.2	<u>27.2</u>	21.6	<u>21.4</u>	24.0	<u>25.6</u>	22.5	<u>22.5</u>	14.9	<u>15.6</u>
B-36	27.2	32.2	27.2	30.4	32.3	33.0	23.5	25.4	20.6	21.5
B-44	25.0	32.3	26.6	31.7	28.4	32.0	21.0	24.9	18.3	18.9
B-54	24.0	<u>32.2</u>	23.0	<u>30.8</u>	23.8	<u>30.1</u>	18.8	<u>24.1</u>	17.1	<u>19.1</u>
B-60	24.8	<u>31.5</u>	22.0	<u>31.5</u>	20.7	<u>29.2</u>	16.6	<u>18.8</u>	15.9	<u>17.6</u>
B-68	23.4	30.9	23.2	31.4	21.2	29.4	16.4	21.1	15.9	16.3
SWP									18.5	<u>18.0</u>
CL-A	16.7	17.1	14.4	14.0	13.0	13.0	15.7	15.6	14.9	14.9
CL-B					11.0	11.0	13.7	13.6	14.9	14.6
DBB	23.0	22.8	16.8	18.7	18.4	18.4	20.3	20.3	20.6	20.6
DR	24.3	24.2	20.4	20.2	21.8	21.8	22.1	22.8	19.6	
TCD	27.5	27.5	28.6	28.5	26.0	26.0	22.5	22.6	21.0	
B-22	26.7	29.6	31.5	31.9	32.8	32.8	22.5	25.2	22.0	
GH	26.3	31.7	31.6	32.2		22.0	24.3	25.4		
BP	29.5	29.4	24.2	24.1	25.8	26.0	24.6	24.8	21.7	
CC	23.2	25.7	23.0	23.2	26.8	26.8	23.3	23.8	21.0	
SC									19.7	
SOC	26.8	26.7	17.8	18.0	23.6	24.0	22.1	21.7	19.6	
RB	8.9	26.8	13.0	25.3	14.1	14.7	22.6	22.8	20.0	
UEB	9.8	9.8	13.1	13.3	9.5	9.5	15.2	15.2	13.2	
MEB	20.8	20.7	15.8	16.0	13.4	13.3	20.2	20.3	18.5	
LEB	23.6	23.4	15.5	15.5	19.8	19.8	18.3	18.3	18.5	
EB	24.7	25.4	21.9	24.5	19.2	19.1	21.2	21.5	19.7	
OIC									23.4	
CR									26.7	
MLWB									25.4	
BH									24.0	
SLP									23.2	
MC									23.5	
CB									23.3	
CBC									25.8	
GLC										
GLB									24.6	
WB									24.7	
GC									22.3	

Table 1 - Continued

Station	June		July		August		September		October		November	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
SB	14.8	15.1	20.5	21.6	20.9	20.5	23.1	23.3	23.3	23.5	20.9	21.1
5MP	16.5	19.2	21.6	23.8	21.1	21.2	24.7	24.8	22.1	25.5	22.0	22.5
MP	17.6	18.6	19.8	21.1	19.6	19.7	20.5	23.7	22.0	26.0	19.3	22.2
UGB	15.8	15.7	19.9	19.6	18.7	18.7	19.6	19.5	18.7	21.4	19.8	20.1
MK	12.2	12.2	19.0	19.5	18.4	19.2	19.8	21.6	16.0	17.1	18.5	18.4
FS	12.1	12.2	16.0	16.3	17.8	17.7	20.2	20.6	16.4	21.3	16.5	15.8
UP	12.2	12.2	12.3	12.6	12.9	12.7	20.1	20.0	16.0	19.5	14.1	13.5
AC	9.8	9.8	11.0	11.5	13.8	13.2	14.0	18.4	14.0	19.0	9.6	10.1
DB	11.2	11.0	12.0	12.9	14.1	16.2	16.3	17.5	18.0	19.9	15.2	14.5
LOB	11.0	11.3	13.9	14.3	16.9	16.9	20.2	20.3	19.9	20.5	15.8	16.0
TB	14.2	14.1			22.8	23.1	21.1	20.0	21.5	21.6	16.6	16.5
VI	11.0	11.1	15.5	16.4	23.9	24.4	21.1	20.6	20.0	21.5	17.3	17.0
SP	14.1	14.5	19.5	20.1	24.1	24.2	21.0	21.1	20.3	21.8	18.0	18.0
PAP	17.7	18.0	22.4	23.5	24.2	24.6	20.7	21.6	22.0	23.5	17.4	17.1
B-36	27.1	27.0	29.5	31.5	32.8	32.6	27.5	25.5	25.2	28.0	22.0	23.3
B-44	24.5	26.8	27.3	29.5	28.9	30.1	25.6	27.4	24.8	27.0	21.8	23.6
B-54	22.0	24.9	25.5	27.2	25.4	26.4	26.1	26.2	25.0	25.9	20.6	24.9
B-60	19.4		23.7	25.0	23.8	24.2	23.3	25.5	21.4	25.8	20.6	21.8
B-68	19.1	22.1			23.1	23.3	22.4	23.6	21.8	25.3	20.7	23.5
SWP	20.9	20.7	24.3	24.4	24.0	24.1	21.6	25.5	24.0	24.2	21.2	21.5
CLA	15.7	15.5	19.5	19.5	20.1	19.8	21.1	21.4	20.4	23.0	17.4	19.5
CLB	15.4	15.5	16.0	17.5	18.5	18.8	17.4	21.9	21.3	22.9	16.7	17.1
DBB	20.7	20.5	22.0	23.2	21.9	22.6	22.3	22.3	22.8	23.8	18.4	18.4
DR	23.0	24.0	27.4	27.1	26.4	25.8	26.0	26.0	27.0	25.0	27.4	27.4
TCD	27.0	27.7	30.1	30.2	31.7	31.6	31.7	31.7	26.5	26.8	27.0	27.9
B-22	26.3		32.0	31.7	31.3	34.0	32.0	32.7	28.4	29.3	29.0	30.7
GH	27.1	27.1	30.3	32.0	32.0	33.9	32.4	32.7	30.5	30.7	30.0	30.9
BP	23.2	24.3	24.3	27.0	28.7	29.0	27.8	27.8	23.6	26.8	27.2	27.2
CC	23.5	24.0	23.2	24.5	26.6	26.4	27.6	27.6	22.9	26.4	26.4	26.6
SC	22.5	23.0	20.5	20.5	22.1	22.3			26.4	27.0		
SOC	22.0	22.5	19.0	21.0	22.0	22.5	24.8	24.6	25.7	26.5	25.0	25.3
RB	22.8	23.0	16.6	22.2	19.2	24.2	23.3	25.4	25.0	26.3	26.9	28.6
UEB	17.8	17.5	22.1	16.7	17.1	16.9	19.4	19.4	21.9	21.5	26.6	26.6
MEB	18.1	18.2	18.0	18.4	20.6	20.5	19.8	19.8	22.4	22.7	23.6	23.6
LEB	18.5	18.2	20.3	19.4	21.2	21.6	22.4	22.4	21.8	22.5	23.0	23.0
EB	20.6	20.5	19.7	20.0	23.9	24.7	27.1	27.1	22.6	25.6	23.3	23.3
OIC	27.0	27.6	29.4	29.9	32.9	33.2						
CR	30.6	31.0	29.8	30.2	28.3	28.7						
MLWB	32.0	32.1	30.5	30.7	32.3	31.2						
BH	32.2	32.6	31.9	31.6	32.4	32.5						
SLP	27.9	29.3	34.3	34.5	35.0	34.8						
MC	29.2	32.0	34.1	33.7	35.0	34.2						
CB	31.2	31.5	27.2	31.0	20.9	21.2						
CBC	31.0	31.2	28.1	28.7	28.2	29.3						
GLC	28.9	28.9	28.0	28.3	30.0	34.4						
GLB	28.5	29.5	28.0	27.8	30.5	30.2						
WB	28.2	29.0	27.8	27.6	31.8	32.0						
GC	26.9	27.7	30.1	30.9	33.0	33.1						

Table 2
Water Temperatures (°C.) - Galveston Bay Stations (1964)

Station	January		February		March		April		May	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
SB	11.2	11.0	11.3	11.3	20.2	17.1	19.0	19.0	26.9	26.8
5MP	11.3	10.1	12.5	11.6	16.7	15.4	20.5	19.5	27.3	26.9
MP					19.5	19.5			28.0	27.8
UGB	12.0	12.0	17.0	17.0	20.2	19.9	19.0	18.5	27.8	27.2
MK	12.0	12.0	17.0	17.0			18.0	18.0	27.7	27.1
FS	10.0	10.0	17.0	17.0	18.6	18.6	19.0	19.0	27.5	27.3
UP	10.0	10.0	17.0	17.0	18.9	18.9	19.5	19.0		
AC	10.0	10.0	18.0	18.0	18.0	18.1	20.0	20.0	27.7	27.2
DB	10.0	10.0	19.0	19.0	18.1	18.0	20.5	19.5	27.1	26.7
LOB	11.0	11.0	19.0	19.0	18.2	18.2	20.0	21.0	26.6	26.6
TB	10.4	10.3	11.5	11.4	15.9	16.0	20.0	20.0	27.6	27.3
VI	11.0	11.0	19.0	19.0	15.8	15.6	20.5	20.0	26.9	26.8
SP	10.3	10.2	11.8	11.8	15.8	15.8	20.0	20.0	27.6	27.3
PAP	11.0	10.9	11.8	12.0	16.0	15.8	20.9	20.8	27.4	27.1
B-36	10.4	10.0	11.9	11.7	15.3	15.2	20.7	20.1	27.5	27.2
B-44	10.5	10.0	12.4	11.7	15.4	15.2	21.0	20.2	27.4	26.9
B-54	11.0	10.1	12.6	11.7	15.7	15.1	21.0	20.4	27.2	26.8
B-60	10.8	10.1	12.2	11.7	16.3	16.2	20.9	20.6	26.7	26.5
B-68	11.2	10.0	12.6	11.8	16.0	15.4	21.1	20.6	26.6	26.6
SWP									27.1	26.7
CL-A	13.0	13.0	19.0	19.0	20.4	20.4	21.0	21.0	28.3	28.0
CL-B					20.6	20.6	21.0	21.5	28.5	28.0
DBB	12.0	12.0	18.0	18.0	17.7	17.7	19.5	19.5	27.0	26.9
DR	11.0	11.0	18.0	19.0	18.0	18.0	20.0	19.5	27.0	
TCD	10.0	10.0	18.0	19.0	16.7	16.7	19.5	19.0	26.5	
B-22	10.6	10.0	12.1	11.5	15.3	15.3	20.7	20.0	27.0	
GH	10.4	10.1	11.8	11.8			20.2	20.0	27.6	
BP	7.0	7.0	18.0	18.0	18.2	18.3	20.8	20.8	27.0	
CC	10.0	10.0	18.0	18.0	17.3	17.0	21.3	21.4	28.0	
SC									27.5	
SOC	10.0	10.0	19.0	19.0	18.4	18.0	22.1	21.7	27.5	
RB	10.0	10.0	18.0	18.0	20.3	20.0	22.9	22.8	28.0	
UEB	8.0	8.0	18.0	18.0	20.8	20.8	22.2	22.2	28.0	
MEB	8.0	8.0	18.0	18.0	19.6	19.6	21.9	21.7	27.5	
LEB	7.0	7.0			19.6	19.6	21.5	21.6	28.0	
EB	12.2	12.0	18.0	18.0	18.6	18.6	21.2	20.9	27.0	
OIC									27.0	
CR									26.5	
MLWB									26.5	
BH									26.5	
SLP									26.0	
MC									27.0	
CB									26.5	
CBC									27.2	
GLC									28.0	
GLB									27.2	
WB									27.0	
GC									26.0	

Table 2 - Continued

Station	June		July		August		September		October		November	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
SB	29.0	29.5	29.0		28.5		24.6	24.3	24.5	23.0	15.4	15.6
5MP	29.7	29.6	29.5	29.1	29.9		24.8	24.4	23.4	22.5	15.9	16.3
MP	30.2	29.8	30.0	29.7	29.8		25.5	26.0	24.1	23.2	17.4	16.9
UGB	30.0	30.0	31.0		30.1		24.4	24.3	25.2	24.2	16.0	15.6
MK	29.6	29.4	29.9		29.4		24.6	24.9	24.2	23.7	15.9	16.0
FS	29.4	29.4	29.9		29.5		24.4	24.6	24.1	22.3	15.3	15.5
UP	29.2	29.0	30.2		29.5		24.5	24.4	24.0	22.5	14.5	14.4
AC	28.7	28.9	30.5		29.6		23.9	24.5	24.2	22.2	15.5	14.9
DB	28.6	28.2	31.0		29.5		24.1	24.2	22.8	21.9	15.4	15.2
LOB	28.3	28.3	24.5		29.3		24.1	24.2	23.9	22.1	15.5	15.4
TB	28.3	28.0			29.5		24.3	24.2	22.2	22.0	14.9	14.8
VI	28.6	28.4	30.1		29.8		24.1	23.9	22.3	22.0	15.1	14.9
SP	28.7	28.6	29.4		29.0		24.2	24.3	22.3	22.1	15.2	14.9
PAP	28.7	28.7	29.6		28.8		24.5	24.3	25.2	22.8	15.4	15.2
B-36	29.4	29.5	29.6		28.9		25.9	26.3	23.8	22.9	15.6	16.5
B-44	29.2	29.4	30.2		29.0		24.4	26.2	24.8	22.6	16.0	16.5
B-54	29.0	29.6	29.0	29.4	28.5		25.1	25.6	22.9	22.4	15.9	16.4
B-60	29.2	29.9	29.4	29.0	28.8	28.5	25.3	25.2	24.5	22.7	16.0	16.2
B-68	29.4	29.6	29.2	28.9	28.6		25.0	25.1	23.5	22.5	15.7	16.2
SWP	28.9	28.9	29.2		28.6				23.9	22.4	15.7	15.4
CL-A	30.1	29.8	29.0		29.0		24.1	24.5	28.3	24.1	16.4	15.9
CL-B	29.9	29.6	28.5		29.5		24.2	24.4	24.9	23.6	16.5	16.4
DBB	29.5	28.6	28.0		28.7		25.1	25.1	23.1	22.5	24.5	24.5
DR	29.6		29.1		29.1		24.8	24.8	22.9		23.9	23.9
TCD	29.5		29.9		29.8		27.6	27.4	23.2	22.5	23.8	23.6
B-22	29.0		29.8	28.5	28.9	28.8	28.6	28.8	22.8	22.4	24.0	23.3
GH	29.5	29.0	30.3	29.0	29.4	28.9	29.4	28.3			29.9	23.3
BP	28.6		31.1		28.5		25.0	25.0	23.5		24.0	24.0
CC	28.9	28.9	31.2		28.2		26.2	26.1	23.6	22.9	24.3	24.2
SC	28.9		30.2		28.1				23.5	23.4		
SOC	28.9	28.6	32.1	28.5	28.7	28.4	26.3	26.1	23.5	23.4	24.7	24.6
RB	27.8	28.7	31.1	29.0	28.2	27.9	26.3	25.9	23.1	23.9	26.4	25.3
UEB	27.6		31.1		28.3		24.8	24.8	24.6		25.3	25.3
MEB	28.4				28.4		25.1	25.1	24.6		25.0	25.0
LEB	28.2				27.6		24.8	24.8	24.2		24.7	24.7
EB	28.6				27.9		27.5	27.5	24.3		24.0	24.0
OIC	29.5		29.3		29.3							
CR	28.8		30.8		30.3							
MLWB	28.9		30.3		29.9							
BH	28.9		29.7		29.9							
SLP	29.1		29.3		30.3							
MC	29.5		30.3		28.6							
CB	28.7		29.7	28.6	30.1	28.9						
CBC	29.0		30.3	28.1	29.5							
GLC	28.8		31.4		29.6							
CLB	29.3		29.4		29.5							
WB	28.9	29.0	29.1		29.7							
GC	28.9	28.9	30.5		29.4	28.9						

Table 3
 Meteorological Data - Galveston Airport (1964)

	<u>Jan.</u>	<u>Feb.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>
Average Air Temp. (°F)	52.1	51.5	59.9	69.4	76.6	80.6	82.3	83.8	80.5	69.8	65.8	55.5
Temperature Range (°F)												
Avg. Maximum	57.1	56.7	64.7	72.8	80.1	84.4	86.7	88.0	84.5	75.2	70.5	61.3
Avg. Minimum	47.1	46.2	55.0	65.9	73.3	76.8	77.8	79.6	76.4	64.4	61.1	49.7

Table 4
 Prevailing Wind - Houston Airport (1964)

	<u>Jan.</u>	<u>Feb.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>
Prevailing Wind	NNE	NNE	SSE	SSE	SE	SSE	SSE	S	SE	NNE	SE	N
Per Cent of Time Prevailing	7	7	10	19	11	15	7	12	14	8	7	8

Figure 1
 Hydrographic Stations - Galveston Bay Area

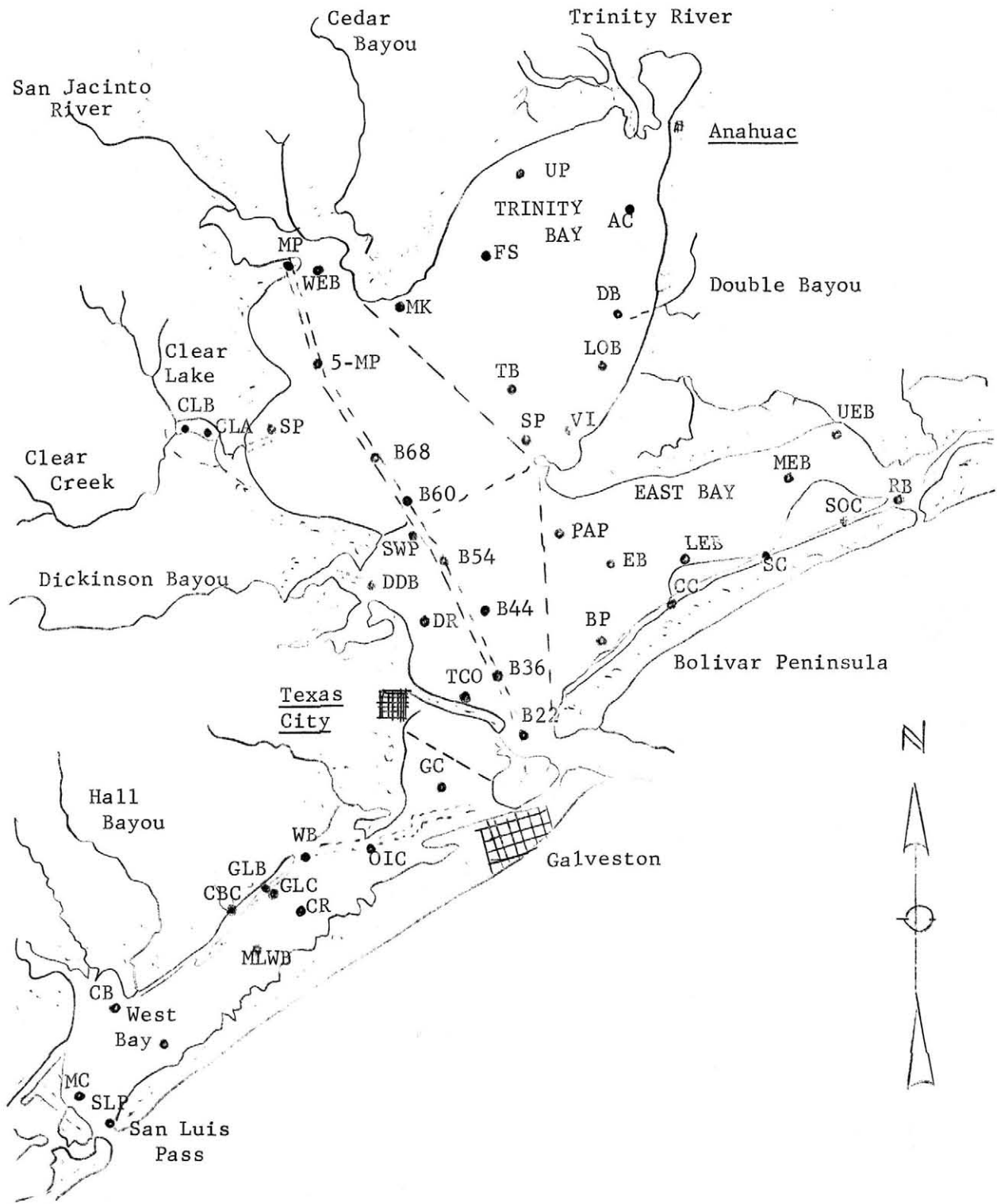
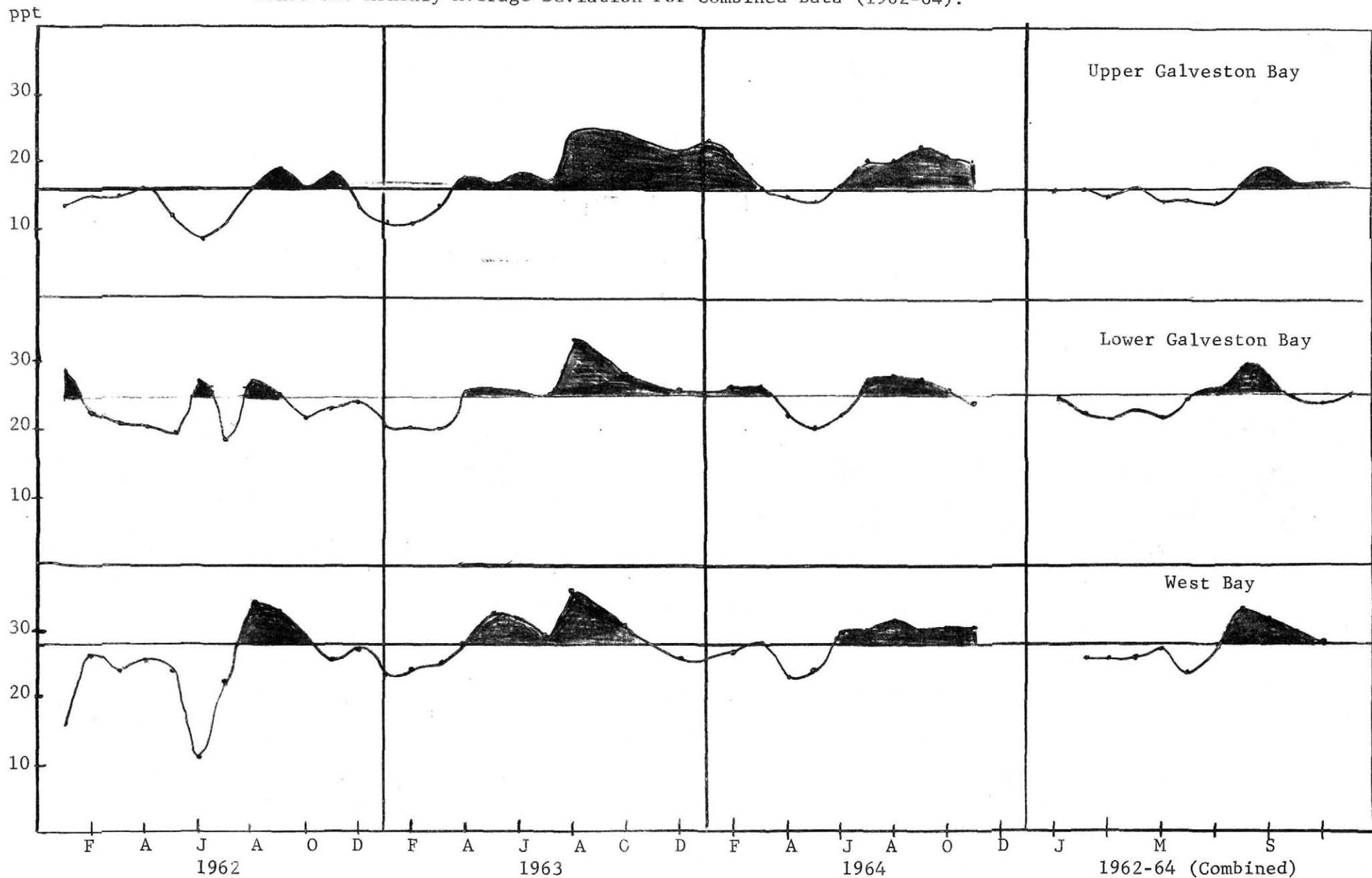


Figure 2
 Average Monthly Salinities For Six Large Areas of the Galveston Bay System (1962-64)
 Presented as Deviations From A Three Year Average. Shaded Areas Represent Above
 Average Salinities During the Three Year Period. The Figure On the Right Represents
 the Monthly Average Deviation For Combined Data (1962-64).



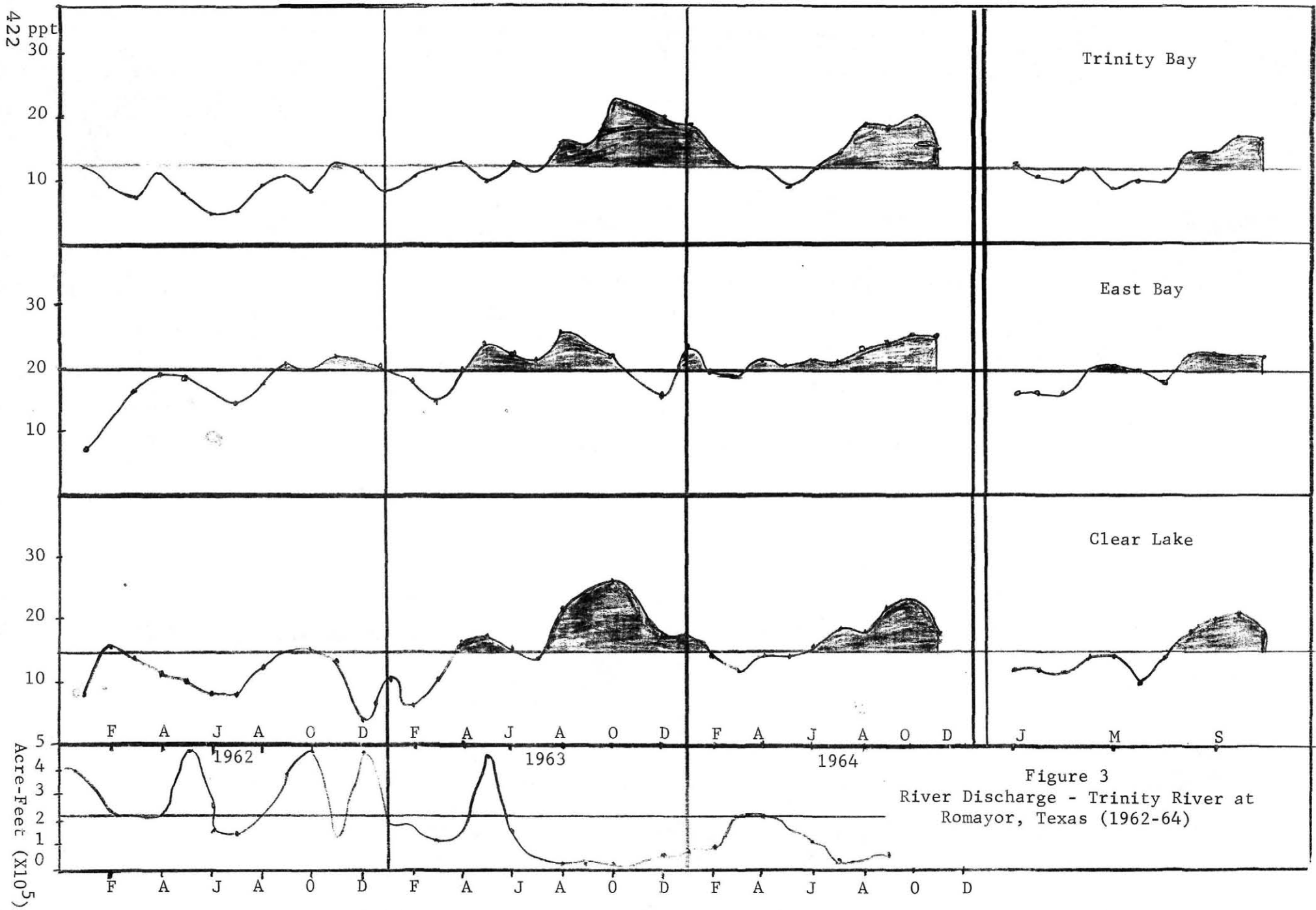


Figure 3
 River Discharge - Trinity River at
 Romayor, Texas (1962-64)

Figure 4
Trinity River Discharge at Romayor, Texas - (1951-1964)

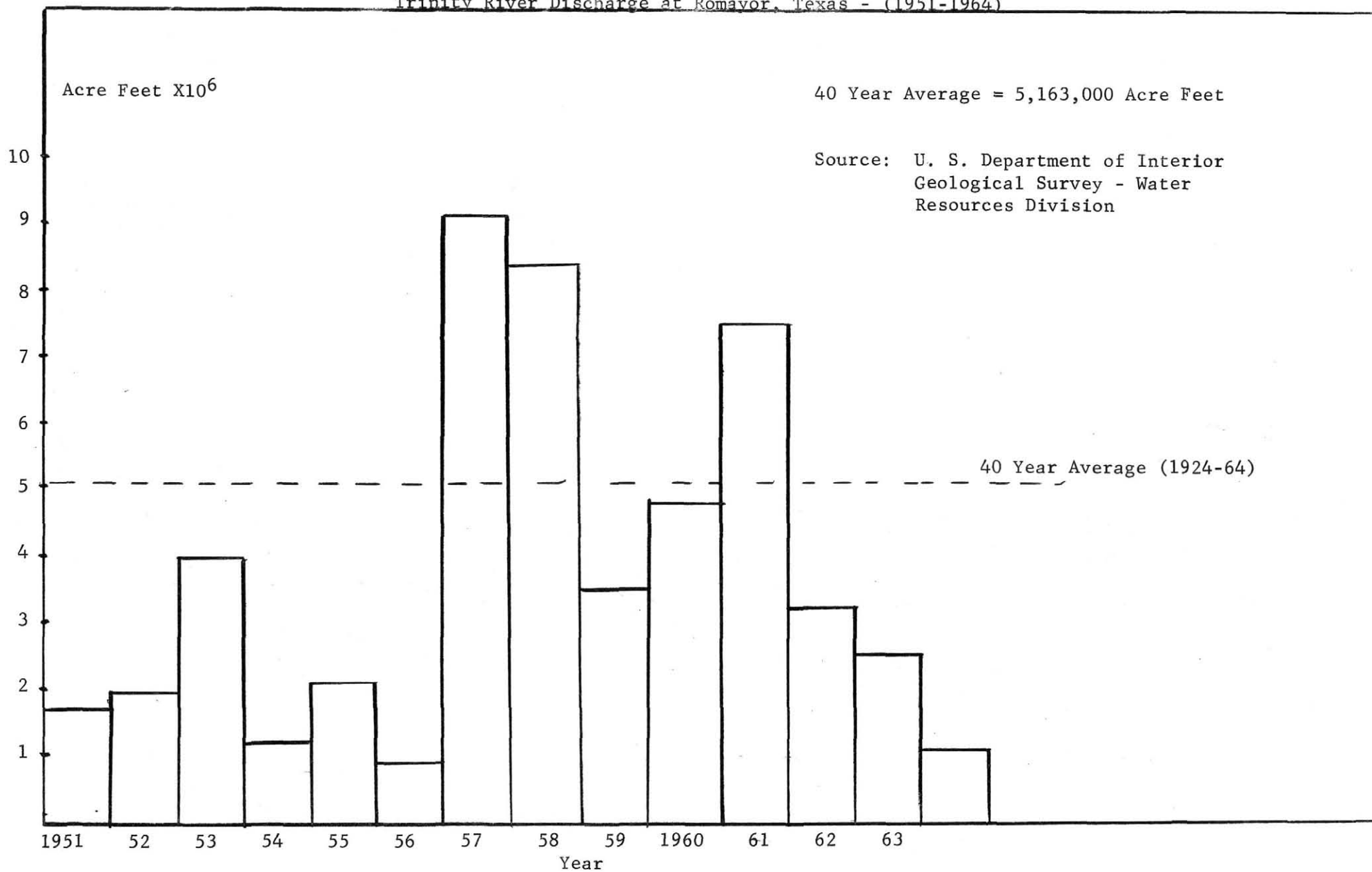


Figure 5
 Total Rainfall at Galveston (WB) Airport

