STATEWIDE FRESHWATER FISHERIES MONITORING AND MANAGEMENT PROGRAM
FEDERAL AID IN SPORT FISH RESTORATION ACT PROJECT F-30-R

Survey Report for the Brazos River, 1994

by

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INTRODUCTION

The Brazos River mainstream begins in Stonewall County and flows approximately 840 miles to the Gulf of Mexico at Brazosport in Brazoria County (Figure 1). The Brazos River drainage area is an estimated 42,800 square miles and annual run-off exceeds 5 million acre feet. The river crosses most physiographic regions of Texas, including: High Plains, West Texas Lower Rolling Plains, West Texas Cross Timbers, Grand Prairie, and Gulf Coast Plains (Kingston 1992).

Upper Brazos River: Stonewall County to Parker County (Figure 2). The watershed is generally rangeland with heavily wooded hills and valleys and flat cleared areas for agricultural use (Miertschin et al 1989). This section of the river receives inflows from the Salt Fork, Double Mountain Fork, Clear Fork, and North Fork. Public access and recreational opportunities are limited above Possum Kingdom Lake. The uppermost mainstream reservoir is Possum Kingdom Lake (17,700 acres) in Palo Pinto County. The reservoir provides flood control, recreation, and hydropower production and the dam is 688 river-miles from the Texas Gulf Coast. Flows below the reservoir depend on flood prevention and hydropower release schedules. Approximately 1-mile of river is accessible to the public immediately below the Possum Kingdom Lake Dam and at major highway crossings further downstream. This portion of stream provides excellent recreational opportunities for canoeing and for angling. The river is clear and shallow with alternating sand bars, gravel outcroppings, and shallow pools. Water from the upper watershed has little value for municipal or industrial use because of a high salt content.

Middle Brazos River: Parker County to Falls County (Figure 3). This portion of the watershed consists of rocky, timbered hills and large expanses of flat land used for agriculture. The streambed is shallow and clear with numerous sand and gravel bars and shallow pools. River banks vary from rocky cliffs and boulders to high sand banks. Lake Granbury (8,700 acres) is located in Hood County; the dam is 543 river-miles from the coast. This reservoir is primarily used for flood control, recreation, and a municipal water supply. About 67 river-miles downstream, Lake Whitney (23,560 acres) is bordered by Hill and Bosque Counties; the dam is 442 river-miles from the coast. This impoundment is used for flood control, recreation, and hydropower production. An estimated 40 river-miles below Lake Whitney is Lake Brazos, a 109-acre reservoir within the City of Waco in McLennan County. The reservoir is impounded by a low-water hydraulic dam (400 river-miles from the coast) used for flood control. The last barrier to upstream fish migrations , except during flood events, is at Marlin Falls in Falls County (347 river-miles from the coast). The falls include a low-water dam with a drop of about 4-5 feet in the streambed. Major tributaries to the middle portion of the Brazos River include Squaw Creek and the Paluxy River in Hood County , the Nolan River in Hill County, and Aquilla Creek and the North, South, and Middle Bosque Rivers in McLennan County. Public access and angling opportunities are good along most of the

middle Brazos River area with numerous highway crossings, boat ramps, parks, and commercial campgrounds. Canoeing is also popular below Lake Whitney. Past pollution problems have included dairy and cattle feed-lot runoff, pesticide contamination, illegal industrial discharge, illegal sand and gravel dredging operations, illegal discharge of sediment from nearby sand and gravel pits, and illegal construction within the river bottom. Although there is a considerable amount of industrial development in the Waco area, no long-term problems are known to exist.

Lower Brazos River: Falls County to the Gulf of Mexico (Figure 4), approximately 347 miles of stream. The lower portion of the Brazos River passes through post oak savannah and coastal prairie from Falls county to Brazosport (Brazoria County) on the Texas Gulf Coast. Major tributaries include the Leon River and Little River (Robertson County), Yegua Creek (Burleson County), the Navasota River (Washington County), and Allen's Creek (Austin County). The topography in this portion of the watershed is mostly rolling hills and flat sand and clay fields and timbered areas. Land uses are primarily agricultural, residential, and industrial. Most industry is in the lower portion of the watershed. In the lower portion of the drainage near the coast, potential sources of pollution are mostly industrial, particularly from the Dow Chemical complex in Brazoria County. Overall, public access in the lower Brazos River is limited by shallow water depth and private ownership of land adjacent to the river. Most access is located at highway crossings or near municipalities.

Fish species stocked in the Brazos River are shown in Table 1 and fish harvest regulations are shown in Table 2. Other management activities have been mostly limited to pollution monitoring and documentation, flow recommendations, and comments on environmental impacts of proposed projects associated with existing reservoirs.

METHODS

- Sampling access and stream characteristics dictated suitability of sampling methods for each site. Fish collections were made by: seining at 8 sites on the upper, 6 sites on the middle, and 5 sites on the lower Brazos River; electrofishing at 6 sites on the middle and 5 sites on the lower Brazos River; hoop netting at 3 sites on the upper and 5 sites on the middle Brazos River; and gill netting at 5 sites on the middle Brazos River. Catch rate (CPUE) for seining was recorded as the total number of each species per foot seined at each site; CPUE for electrofishing was recorded as total number of each species captured per hour of actual electrofishing time; CPUE for hoop netting was recorded as total number of each species caught in one net set overnight; and CPUE for gill netting was recorded as total number of each species caught in one net set overnight . Sampling equipment and techniques were according to TPWD (1993).

- Sampling statistics for fish collections included CPUE, proportional stock density (PSD), relative stock density (RSD), and relative weight (Wr). Calculations of structural indices were calculated on selected species according to Anderson and Gutreuter (1983) and Childress (1989).

- Age and growth procedures were implemented on selected species according to procedures shown in TPWD (1993). Otoliths were used to age largemouth bass, spotted bass, and white crappie; scales were used to age white bass and striped bass; and pectoral spines were used to age blue, channel, and flathead catfish.

- Flow data were obtained from US Geological Survey (USGS) records (USGS 1995). The nearest USGS station upstream from actual sampling sites was used to estimate flows for each site where data were available. Sampling stations, followed by USGS station numbers (in parentheses), were as follows: U-1 (08080500), U-2 (08082000), U-5 (08082500), U-6 (08088000), U-7 (08088600), M-1 (08090800), M-3 (08091000), M-4 (08093100), M-5 (08096500), M-6 (08098290), L-2 (08108700), L-5 (081115000), and L-6 (08116650).

- Water quality data were taken for upper and middle Brazos River stations from USGS records at the same stations used for flow estimates where data were available. Lower Brazos River sites were actual measurements from samples obtained during surveys; samples were analyzed using a Hach DREL water analysis kit.

- Habitat estimates were made at 5 sites on the middle Brazos River. Techniques were those shown in TPWD (1993). In addition, the entire river from the Gulf of Mexico to Seymour, Texas, was videotaped to assist in identifying accessible sampling stations and in evaluating habitat characteristics.

- Freshwater mussels were collected in conjunction with other river survey activities. Samples were forwarded to Robert G. Howells, TPWD, for species identification.

RESULTS

River Basin Summaries

- Catch rates of fish species collected at upper, middle, and lower Brazos River sampling sites are shown in Table 3, 4, and 5.
- A checklist of all fish species collected during 1994 surveys of the Brazos River are shown in Table 6.
- A summary of age and growth results for selected fish species is presented in Table 7.
- Flow characteristics for the upper Brazos River are shown in Figure 5, the middle Brazos River in Figures 6 and 7, and the lower Brazos River in Figure 8. Depth profiles and related data from middle Brazos River surveys are shown in Figures 9 and 10.
- Water quality data from the upper, middle, and lower Brazos River are presented in Table 8.
- Habitat estimates from on-site surveys on the middle Brazos River are presented in Table 9.
- A checklist of freshwater mussel species collected from all sites is presented in Table 10.

Summary from Fish Species Collections

Channel, blue and flathead catfishes

- Catch rates of selected sizes and structural indices (PSD, RSD_{12}, and RSD_{14}) for catfishes collected by all methods in 1994 are presented in Table 11.

Largemouth and spotted bass

- Catch rates of selected sizes and structural indices (PSD and RSD_{14}) for largemouth bass and spotted bass collected by all methods in 1994 are presented in Table 12.

- Results of electrophoretic analyses of largemouth bass collected in 1994 are presented in Table 13.

White bass and white crappie

- Catch rates of selected sizes and structural indices (PSD and RSD_{10}) of white bass and white crappie collected by all methods are presented in Table 14.

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Table 1. Checklist of fish species stocked by Texas Parks and Wildlife Department in mainstream locations on the Brazos River, Texas, from 1965 through 1994.

	Stocking Location				
Species	Lake Brazos	Lake Whitney	Lake Granbury	Lake Possum Kingdom	Possum Kingdom Tailrace
Threadfin shad				X	
Rainbow trout					X
Blue catfish		X	X		
Channel catfish	X	X	X	X	
Striped bass		X	X	X	X
Smallmouth bass		X	X	X	
Largemouth bass		X	X	X	
Florida largemouth bass		X	X	X	

Table 2. Sportfish harvest regulations for the Brazos River, Texas, 1994.

Species	Daily bag limit	Possession limit	Minimum Size limit (inches)
Catfish (blue and channel)	25	50	12
Flathead catfish	5	10	18
Striped bass	5	15	18
White bass	25	50	10
Smallmouth bass[1,2]	5	10	14
Largemouth bass[1,3]	5	10	14
Spotted bass[1]	5	10	12
Crappie (black and white)	25	50	10
Rainbow trout	5	10	None

1) Daily bag and possession limits apply to the total aggregate of smallmouth bass, largemouth bass, and spotted bass.
2) The minimum size limit of smallmouth bass in Lake Whitney is 18 inches.
3) The minimum size limit of largemouth bass in Lake Granbury is 16 inches.

Table 3. Summary of catch rates by seining (total feet seined and number collected), and hoop netting (number per net) at all sampling sites on the upper section of the Brazos River in June, July, and August, 1994. Sampling efforts are shown in parentheses.

Site	Species	Seining	Hoop Nets
U-1		(75 ft)	
	Red shiner	2	
	Plains minnow	65	
	Plains killifish	3	
	Western mosquitofish	9	
U-2		(80 ft)	
	Red River pupfish	480	
	Plains killifish	5	
U-3		(75 ft)	
	Plains minnow	380	
	Red River pupfish	16	
	Plains killifish	1	
	Western mosquitofish	6	
U-4		(50 ft)	
	Common carp	1	
	Plains minnow	399	
	Red River pupfish	3	
	Western mosquitofish	10	
U-5		(30 ft)	
	Common carp	1	
	Plains minnow	58	
	River carpsucker	1	
	Plains killifish	3	
	Western mosquitofish	10	

Table 3. (Continued)

Site	Species	Seining	Hoop Nets
U-6		(720 ft)	
	Longnose gar	15	
	Gizzard shad	6	
	Red shiner	10	
	Plains minnow	1,466	
	Speckled chub	4	
	Suckermouth minnow	8	
	Bullhead minnow	1	
	Channel catfish	1	
	Inland silverside	22	
	White crappie	1	
	Freshwater drum	1	
U-7		(1,068 ft)	(5 net nights)
	Common carp	-	0.40
	Central stoneroller	3	-
	Red shiner	313	-
	Blacktail shiner	100	-
	Bullhead minnow	29	-
	River carpsucker	2	-
	Plains killifish	2	-
	Western mosquitofish	80	-
	Inland silverside	12	-
	White bass	1	-
	Bluegill	8	3.20
	Longear sunfish	-	1.40
	Spotted bass	4	-
	Largemouth bass	8	-

Table 3. (Continued)

Site	Species	Seining	Hoop Nets
U-8		(1,056 ft)	(5 net nights)
	Red shiner	125	-
	Blacktail shiner	32	-
	Suckermouth minnow	2	-
	Bullhead minnow	5	-
	River carpsucker	-	0.20
	Channel catfish	-	0.20
	Inland silverside	6	-
	Warmouth	-	0.20
	Bluegill	-	0.40
	Longear sunfish	4	-
	Redear sunfish	1	-
	Spotted bass	12	-
	Largemouth bass	7	-

Table 4 . Summary of catch rates by seining (total feet seined and number collected), electrofishing (number per hour), hoop netting (number per net), and gill netting (number per net) at all sampling sites on the middle section of the Brazos River, August, 1994. Sampling efforts are shown in parentheses.

Site	Species	Seining	Electrofishing	Hoop Nets	Gill Nets
M-1		(300 ft)	(0.83)	(5 net nights)	(5 net nights)
	Spotted gar	-	-	-	0.20
	Gizzard shad	-	56.63	-	16.00
	Common carp	-	-	-	1.00
	Red shiner	9	-	-	-
	Blacktail shiner	2	-	-	-
	River carpsucker	-	-	-	2.20
	Smallmouth buffalo	-	-	-	3.20
	Blue catfish	-	1.20	-	-
	Channel catfish	-	-	-	6.20
	Flathead catfish	-	10.84	-	-
	Western mosquitofish	2	-	-	-
	Inland silverside	9	-	-	-
	White bass	-	-	-	0.60
	Bluegill	1	10.84	0.60	-
	Largemouth bass	-	3.61	-	0.40
	White crappie	-	-	1.20	1.80
	Freshwater drum	-	1.20	-	1.00
M-2		(300 ft)	(0.33 hr)		
	Gizzard shad	-	184.85		
	Common carp	-	30.30		
	Red shiner	11	-		
	Blacktail shiner	51	-		
	River carpsucker	-	15.15		
	Smallmouth buffalo	-	6.06		
	Flathead catfish	-	12.12		
	Western mosquitofish	5	-		
	Inland silverside	204	-		
	White bass	-	9.09		
	Striped bass	-	3.03		

Table 4 . (Continued)

Site	Species	Seining	Electrofishing	Hoop Nets	Gill Nets
M-2 (continued)					
	Bluegill	-	24.24		
	Longear sunfish	2	-		
	Spotted bass	-	12.12		
	Largemouth bass	1	15.15		
M-3		(300 ft)	(0.5 hr)	(4 net nights)	(5 net nights)
	Spotted gar	-	-	-	0.60
	Longnose gar	-	-	-	0.20
	Gizzard shad	-	54.00	-	5.40
	Common carp	-	-	-	0.80
	Red shiner	31	-	-	-
	Blacktail shiner	43	-	-	-
	Bullhead minnow	2	-	-	-
	River carpsucker	-	-	-	3.40
	Smallmouth buffalo	-	-	-	1.40
	Blue catfish	-	-	-	-
	Channel catfish	-	6.00	-	3.20
	Flathead catfish	-	14.00	-	-
	Inland silverside	102	-	-	-
	Green sunfish	-	6.00	-	-
	Warmouth	-	4.00	-	-
	Bluegill	-	58.00	1.00	-
	Spotted bass	-	8.00	-	-
	Largemouth bass	7	46.00	-	0.40
	White crappie	-	-	0.50	0.40
	Black crappie	-	-	-	0.40
	Freshwater drum	-	-	-	0.40
M-4		(1,300 ft)	(1.25 hr)	(5 net nights)	(5 net nights)
	Spotted gar	-	2.40	-	-
	Longnose gar	-	-	-	0.20
	Gizzaard shad	-	64.80	-	2.00
	Common carp	-	15.20	-	-

Table 4. (Continued)

Site	Species	Seining	Electrofishing	Hoop Nets	Gill Nets
M-4 (continued)					
	Red shiner	1	-	-	-
	Blacktail shiner	884	-	-	-
	Golden shiner	5	-	-	-
	River carpsucker	-	-	-	0.80
	Smallmouth buffalo	-	0.80	-	0.80
	Blue catfish	-	-	-	0.20
	Channel catfish	-	5.60	-	4.80
	Flathead catfish	-	3.20	-	-
	Gulf killifish	12	-	-	-
	Inland silverside	1,626	-	-	-
	Redbreast sunfish	-	4.00	-	-
	Warmouth	-	2.40	-	0.20
	Bluegill	-	31.20	1.00	-
	Longear sunfish	-	52.80	0.40	-
	Redear sunfish	-	16.80	-	-
	Spotted bass	-	16.80	-	-
	Largemouth bass	1	31.20	-	-
	White crappie	-	-	0.40	0.40
	Freshwater drum	-	5.60	-	1.20
M-5		(1,050 ft)		(5 net nights)	(5 net nights)
	Longnose gar	-		0.20	3.00
	Bowfin	-		-	0.20
	Gizzard shad	-		-	5.80
	Threadfin shad	45		-	-
	Red shiner	37		-	-
	Blacktail shiner	45		-	-
	Golden shiner	294		-	-
	River carpsucker	-		0.40	-
	Smallmouth buffalo	-		-	0.20
	Channel catfish	-		-	0.60
	Inland silverside	353		-	-
	Bluegill	2		0.20	-
	Largemouth bass	-		0.20	-

Table 4. (Continued)

Site	Species	Seining	Electrofishing	Hoop Nets	Gill Nets
M-5 (Continued)					
White crappie		-	-	0.80	-
Freshwater drum		-	-	-	0.60
M-6		(800 ft)	(1.25 hr)	(5 net nights)	(5 net nights)
	Longnose gar	-	3.20	0.20	0.40
	Gizzard shad	-	107.20	-	-
	Threadfin shad	1	-	-	-
	Common carp	-	12.80	-	0.40
	Red shiner	157	-	-	-
	Golden shiner	385	-	-	-
	Bullhead minnow	110	-	-	-
	River carpsucker	-	6.40	-	-
	Channel catfish	-	27.20	-	-
	Flathead catfish	-	7.20	-	-
	Inland silverside	14	-	-	-
	Bluegill	-	8.80	-	-
	Longear sunfish	-	6.40	1.60	-
	Redear sunfish	-	5.60	-	-
	Spotted bass	-	20.00	-	0.80
	Largemouth bass	-	8.80	-	0.20
	White crappie	-	0.80	0.20	-
	Freshwater drum	-	4.00	-	0.20

Table 5. Summary of catch rates by seining (total feet seined and number collected) and electrofishing (number per hour) at all sampling sites on the lower section of the Brazos River, July and August, 1994. Sampling efforts are shown in parentheses.

Site	Species	Seining	Electrofishing
L-1		(1,870 ft)	(1.55 hr)
	Spotted gar	-	1.29
	Gizzard shad	-	2.58
	Threadfin shad	28	1.29
	Red shiner	578	-
	Sharpnose shiner	2	-
	Silverband shiner	5	-
	Bullhead minnow	1,115	-
	River carpsucker	173	1.29
	Smallmouth buffalo	-	0.65
	Blue catfish	-	3.23
	Channel catfish	8	21.94
	Flathead catfish	-	19.35
	Bluegill	3	-
	Dusky darter	9	-
	Freshwater drum	-	1.29
L-2		(1,227ft)	(2.04 hr)
	Spotted gar	-	6.86
	Longnose gar	1	1.47
	Gizzard shad	-	3.43
	Threadfin shad	40	0.98
	Common carp	-	1.47
	Red shiner	529	-
	Speckled chub	1	-
	Bullhead minnow	61	-
	Mimic shiner	1	-
	River carpsucker	18	-
	Smallmouth buffalo	-	0.98
	Blue catfish	-	6.86
	Channel catfish	1	8.33
	Flathead catfish	-	18.63
	Western mosquitofish	4	-
	Warmouth	-	0.49

Table 5. (Continued)

Site	Species	Seining	Electrofishing
L-2 (continued)			
	Longear sunfish	2	1.47
	Spotted bass	-	0.98
	Largemouth bass	2	-
	Freshwater drum	-	0.98
L-3		(1,204 ft)	(0.63 hr)
	Gizzard shad	3	3.17
	Threadfin shad	176	1.59
	Red shiner	361	-
	Speckled chub	1	-
	Pallid shiner	9	-
	Ghost shiner	11	-
	Chub shiner	3	-
	Silverband shiner	35	-
	Bullhead minnow	514	-
	River carpsucker	27	3.17
	Blue catfish	5	65.08
	Channel catfish	22	55.56
	Flathead catfish	-	80.85
	Green sunfish	4	-
	Bluegill	4	-
	Longear sunfish	51	-
L-4		(1,503 ft)	(0.69 hr)
	Spotted gar	-	1.45
	Gizzard shad	5	5.80
	Threadfin shad	3	4.35
	Red shiner	49	-
	Mississippi silvery minnow	62	-
	Speckled chub	14	-
	Weed shiner	4	-
	Bullhead minnow	63	2.90
	River carpsucker	23	-

Table 5. (Continued)

Site	Species	Seining	Electrofishing
L-4 (continued)			
	Blue catfish	-	86.96
	Channel catfish	17	26.09
	Flathead catfish	-	20.29
	Western mosquitofish	7	-
	Inland silverside	1	-
	Warmouth	2	-
	Longear sunfish	1	-
L-5		(1,529 ft)	(0.79 hr)
	Spotted gar	-	5.06
	Gizzard shad	1	5.06
	Threadfin shad	267	18.99
	Red shiner	47	2.53
	Mississippi silvery minnow	3	6.33
	Silverband shiner	2	-
	Bullhead minnow	44	1.27
	River carpsucker	7	32.91
	Blue catfish	-	44.30
	Channel catfish	-	58.23
	Flathead catfish	-	69.62
	Western mosquitofish	1	-
	Largemouth bass	1	-
	White crappie	1	1.27
	Black crappie	1	1.27

Table 6. Checklist of fishes collected by all methods, Brazos River, 1994.

Species	Upper Brazos River	Middle Brazos River	Lower Brazos River
Spotted gar	--	X	X
Longnose gar	X	X	X
Bowfin	--	X	--
Gizzard shad	X	X	X
Threadfin shad	--	X	X
Central stoneroller	X	--	--
Common carp	X	X	X
Red shiner	X	X	X
Blacktail shiner	X	X	--
Plains minnow	X	--	X
Speckled chub	X	--	X
Golden shiner	--	X	--
Pallid shiner	--	--	X
Ghost shiner	--	--	X
Sharpnose shiner	--	--	X
Chub shiner	--	--	X
Silverband shiner	--	--	X
Weed shiner	--	--	X
Mimic shiner	--	--	X
Suckermouth minnow	X	--	--
Bullhead minnow	X	X	X
River carpsucker	X	X	X
Smallmouth buffalo	--	X	X
Blue catfish	--	X	X
Channel catfish	X	X	X
Flathead catfish	--	X	X
Red River pupfish	X	--	--
Gulf killifish	--	X	--
Plains killifish	X	--	--
Western mosquitofish	X	X	X
Inland silverside	X	X	X
White bass	X	X	--
Striped bass	--	X	--
Redbreast sunfish	--	X	--

Table 6. (Continued)

Species	Upper Brazos River	Middle Brazos River	Lower Brazos River
Green sunfish	--	X	X
Warmouth	X	X	X
Bluegill	X	X	X
Longear sunfish	X	X	X
Redear sunfish	X	X	--
Largemouth bass	X	X	X
Spotted bass	X	X	X
White crappie	X	X	X
Black crappie	--	X	X
Dusky darter	--	--	X
Freshwater drum	X	X	X

Table 7. Age and average length at capture for species collected from lower and middle sections of the Brazos River, Texas, 1994.

Species	Location	Length (inches) at capture[1] 0	1	2	3	4	5	6
Blue catfish	Middle	-	-	10.0	15.0			
	Lower	-	5.1	15.0	21.3	19.0		
Channel catfish	Middle	-	-	11.5	15.9	19.2	21.3	23.4
	Lower	-	3.0	15.5				
Flathead catfish	Middle	-	-	13.3	18.7	20.4	27.3	35.0
	Lower	-	5.7	13.3	22.9	25.4	35.6	
White bass	Middle	-	-	9.0	10.4	13.0	14.0	
Striped bass	Middle	-	-	13.2				
Spotted bass	Middle	-	8.3	10.6				
Largemouth bass	Middle	6.3	8.6	12.4	13.6	18.1		
White crappie	Middle	-	6.9	9.7	12.4			

1) Lower Brazos River sample lengths are back-calculated to the start of 1994.

Table 8. Physicochemical data for sampling sites on the upper (U), middle (M), and lower (L) Brazos River, Texas, 1994.

Parameter	Sampling Sites[1] U-1	U-2	U-5	M-1	M-6	L-1	L-2	L-3	L-4	L-5	L-6
Secchi (cm)	-	-	-	85	50	40	-	34	20	25	25
Transparency (Jtu)	-	1.0	-	1.8	-	-	-	-	-	-	-
pH	-	7.7	-	8.0	7.8	8.2	8.8	7.7	-	8.3	8.1
Conductivity (micro-mho)	2,850	79,000	6,530	1,700	865	893	864	1,300	1,300	1,900	14,000
Cl^- (mg/l)	550	37,000	1,700	37	120	-	-	-	-	-	-
Salinity (ppt)	-	-	-	-	-		<1	1	<1	6	11.5
TDS (mg/l)	1,820	65,800	4,030	1,010	490	432	448	544	550	403	6,280
Total alkalinity (mg/l as $CaCO_3$)	120	94	160	130	123	154	122	110	130	142	24.4
Total hardness (mg/l as $CaCO_3$)	340	6,400	900	530	290	-	-	-	-	-	-
NH_3^{-3}-N (mg/l)	-	0.50	-	-	0.02	0.23	0.16	0.29	0.27	0.44	0.41
NO_3^--N (mg/l)	-	0.50	-	-	0.02	0.44	0.06	0.44	0.42	0.09	0.25
PO_4^3-P (mg/l)	-	0.03	-	-	0.03	0.29	0.47	0.47	0.30	0.57	0.89
Chlorophyll-*a* (mg/m^3)	-	-	-	-	-	9.38	26.6	33.8	28.5	55.1	24.1

1) Data from sites U-1, U-2, U-5, M-1, and M-6 are from nearest USGS stations upstream from river survey sampling areas (USGS 1995); Secchi measurements at sites M-1 and M-6, and all data for sites L-1 through L-6, are from on-site samples taken during river surveys in 1994.

Table 9 . Summary of habitat characteristics observed during surveys at sites on the middle Brazos River, Texas, August 1994.

Parameter	Sampling Site M-1	M-2	M-3	M-4	M-5	M-6
Channel width (ft)	360	130	257	270	270	200
Maximum depth (ft)	10.0	5.0	2.5	3.0	6.0	3.0
Average depth (ft)	8.7	2.2	2.2	2.0	2.6	1.5
Bank slope (degrees)	15-29	15-29	0-64	0-14	15-29	30-64
Substrate (type)	Sand / Boulder	Gravel	Sand / Boulder	Sand / Pebble	Sand / Gravel	Sand / Gravel
Pool / riffle	N/A	1:4	N/A	1:10	N/A	3:1
Meander (bend/mi)	2	3	2	1	2	1
Clarity (ft)	(2.8)	(3.3)	(3.1)	(2.3)	(3.0)	(2.8)
Conductivity (micromho)	3,700	2,200	2,300	1,500	1,450	1,400
Flow (ft/sec)	0	1.4	0	2.5	0.9	2.1
Canopy (%)	N/A	N/A	N/A	N/A	5	5
Aquatic Vegetation (%)	N/A	N/A	N/A	2	2	3

Table 10 . A checklist of freshwater mussels collected at upper (U), middle (M), and lower (L) sampling sites on the Brazos River, Texas, in July and August, 1994.

Common name	Scientific name	Sampling Sites										
		U[1]	U-7	U-8	M-1	M-4	M-5	M-6	L-1	L-2	L-3	L-4
Tampico pearlymussle	Cyrtonaias tampicoensis	X	X	X	X	X	X	X	X	X	X	X
Rock-pocketbook	Lampsilis ovata									X		
Yellow sandshell	Lampsilis teres			X		X	X	X	X	X	X	
Fragile papershell	Leptodea fragilis					X		X	X	X	X	
Pink papershell	Potamilus ohiensis	X		X	X		X	X	X	X	X	X
Pistolgrip	Tritogonia verrucosa					X	X					
Asian clam	Corbicula sp		X	X	X	X	X	X			X	X
Southern mapleleaf	Quadrula purpuratus				X		X		X		X	X
Smooth pimpleback	Quadrula houstonensis						X		X		X	X
Texas fawnsfoot	Truncilla macrodon						X		X	X	X	X
Bleufer	Potamilus purpuratus						X		X	X	X	X
Threeridge	Amblema plicata								X	X	X	X
Paper pondshell	Anodonta imbecillis	X										

1) Collected at State Highway 283 bridge area on Clear Fork of the Brazos River near Fort Griffen, Texas, July, 1994.

Table 11. Summary of catch of catfish species in the middle and lower Brazos River, Texas, 1994.

Species	Section	N	Number per selected length group >9	>12	>14	>18	PSD	RSD_{12}	RSD_{14}
Blue catfish	Middle	4	3	2	2	1	50	100	50
	Lower	21	16	16	15	10	38	100	63
Channel catfish	Middle	53	51	47	42	23	73	98	48
	Lower	151	2	1	1	0	0	0	0
Flathead catfish	Middle	24	16	13	8	5	33	87	33
	Lower	187	47	30	25	16	59	94	50

Table 12 . Summary of largemouth and spotted bass catch and structural indices from the middle Brazos River, Texas, 1994.

Species	N	Range (inches)	Number per selected length group >8	>12	>14	PSD	RSD_{14}
Largemouth bass	87	2-18	53	20	4	38	7
Spotted bass	53	3-15	29	5	4	31	7

Table 13. Summary of electrophoretic analyses of largemouth bass collected from the middle Brazos River, Texas, August 1994.

	Site M-4	Site M-6
Sample size	8	14
Florida largemouth bass	0	0
F_1 hybrid	0	0
F_X hybrid	1	3
Northern largemouth bass	7	11
% Florida largemouth alleles	9.38%	5.36%

Table 14. Summary of white bass and white crappie catch and structural indices from the middle Brazos River, Texas, 1994.

Species	N	Number per selected length group Range (inches)	>5	>10	PSD	RSD_{14}
White bass	3	8-14	3	2	67	67
White crappie	15	6-11	15	3	60	20

BRAZOS RIVER BASIN

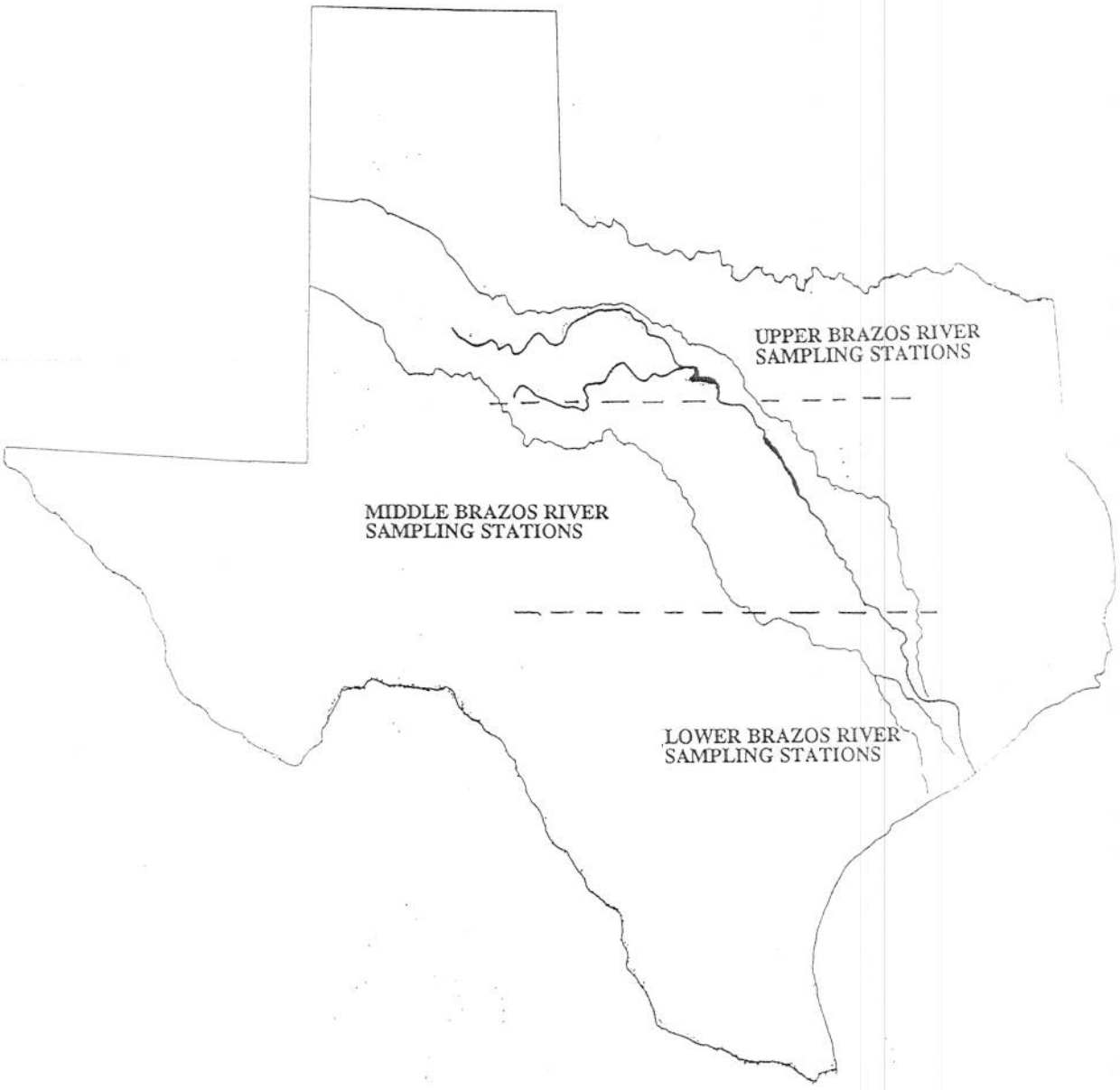

Figure 1. Location of upper, middle, and lower major sections sampled on the Brazos River, Texas. 1994.

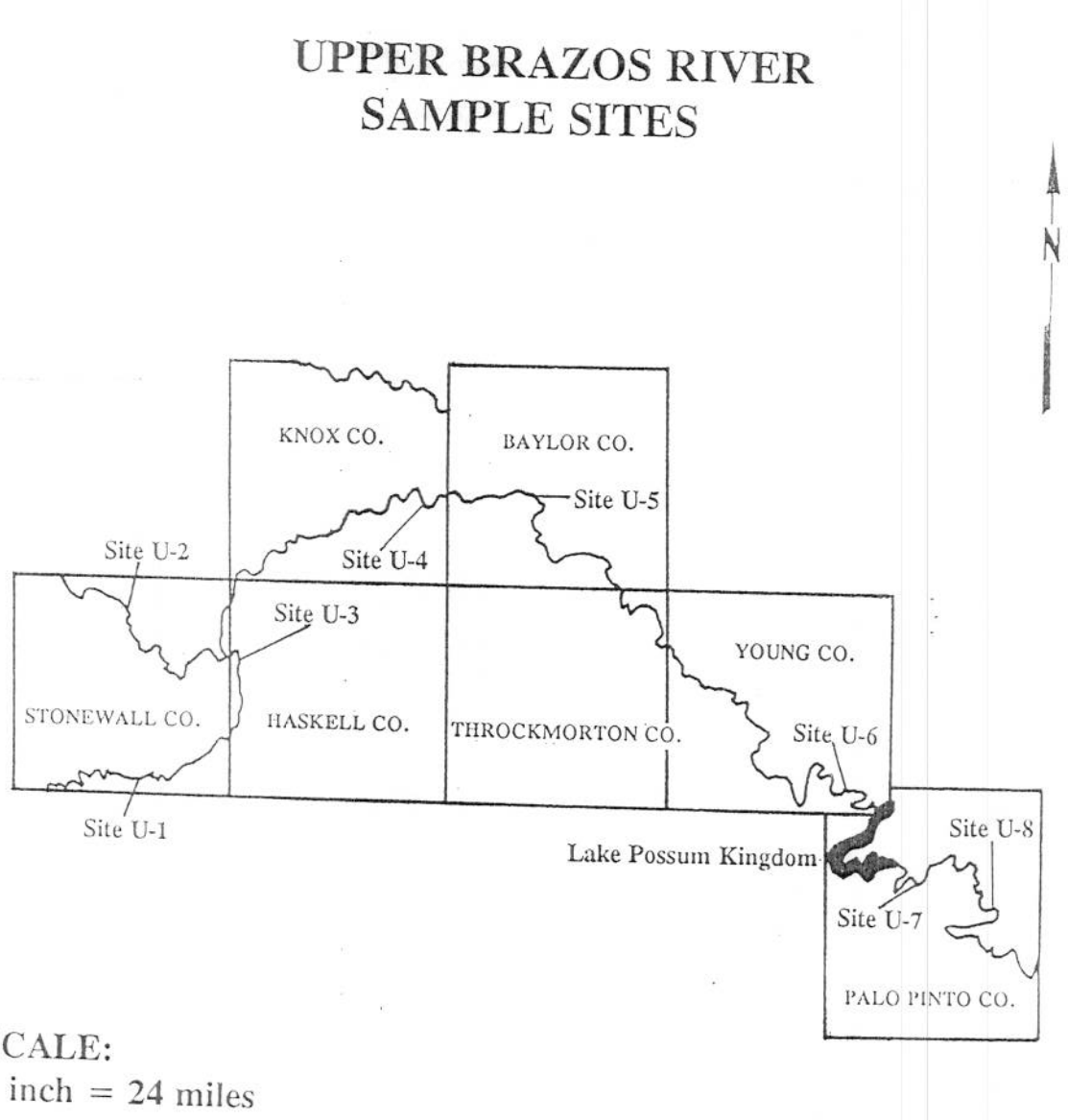

Figure 2. Location of sample sites on the upper Brazos River, Texas, 1994.

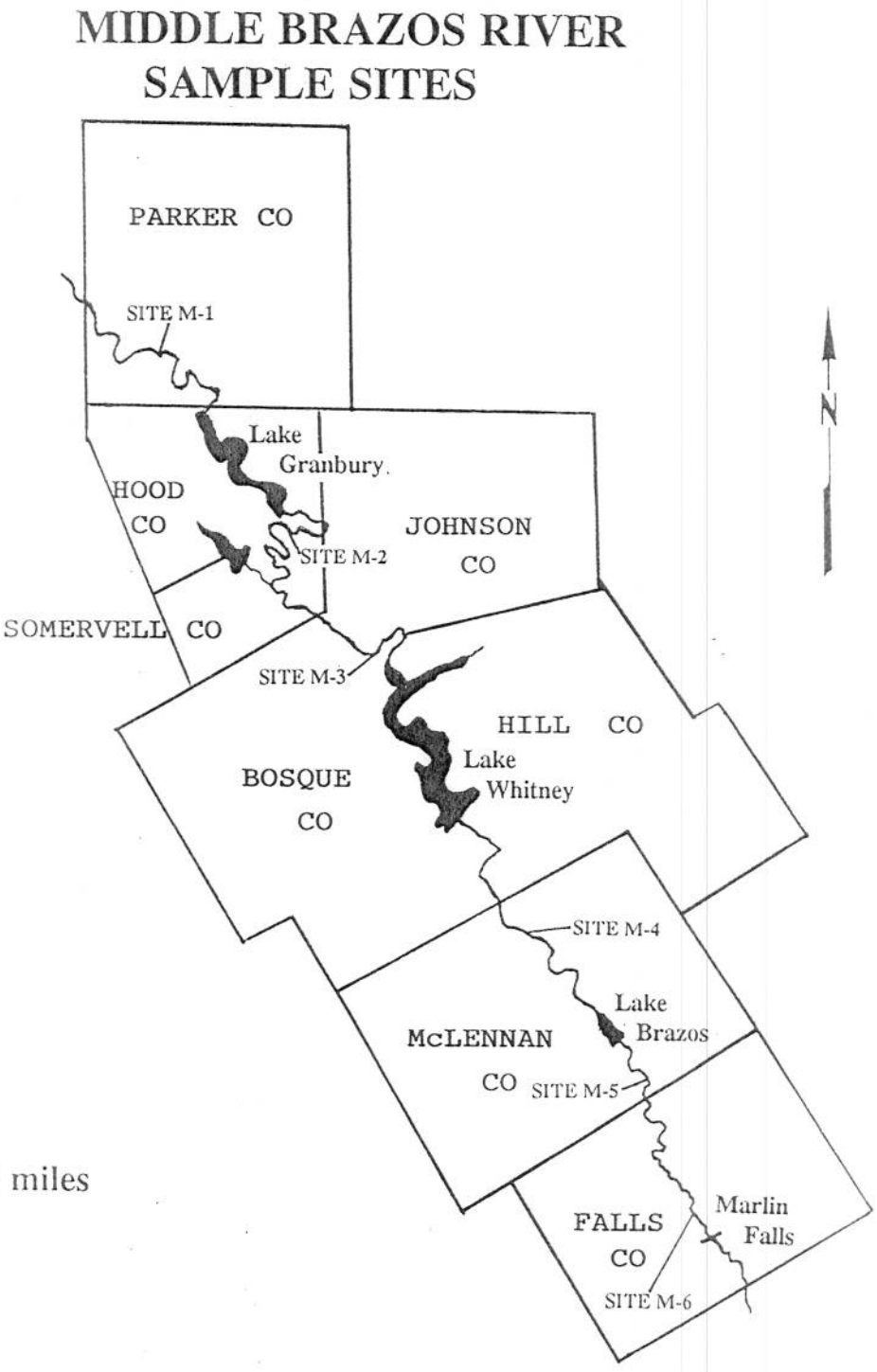

Figure 3. Location of sample sites on the middle Brazos River, Texas, 1994.

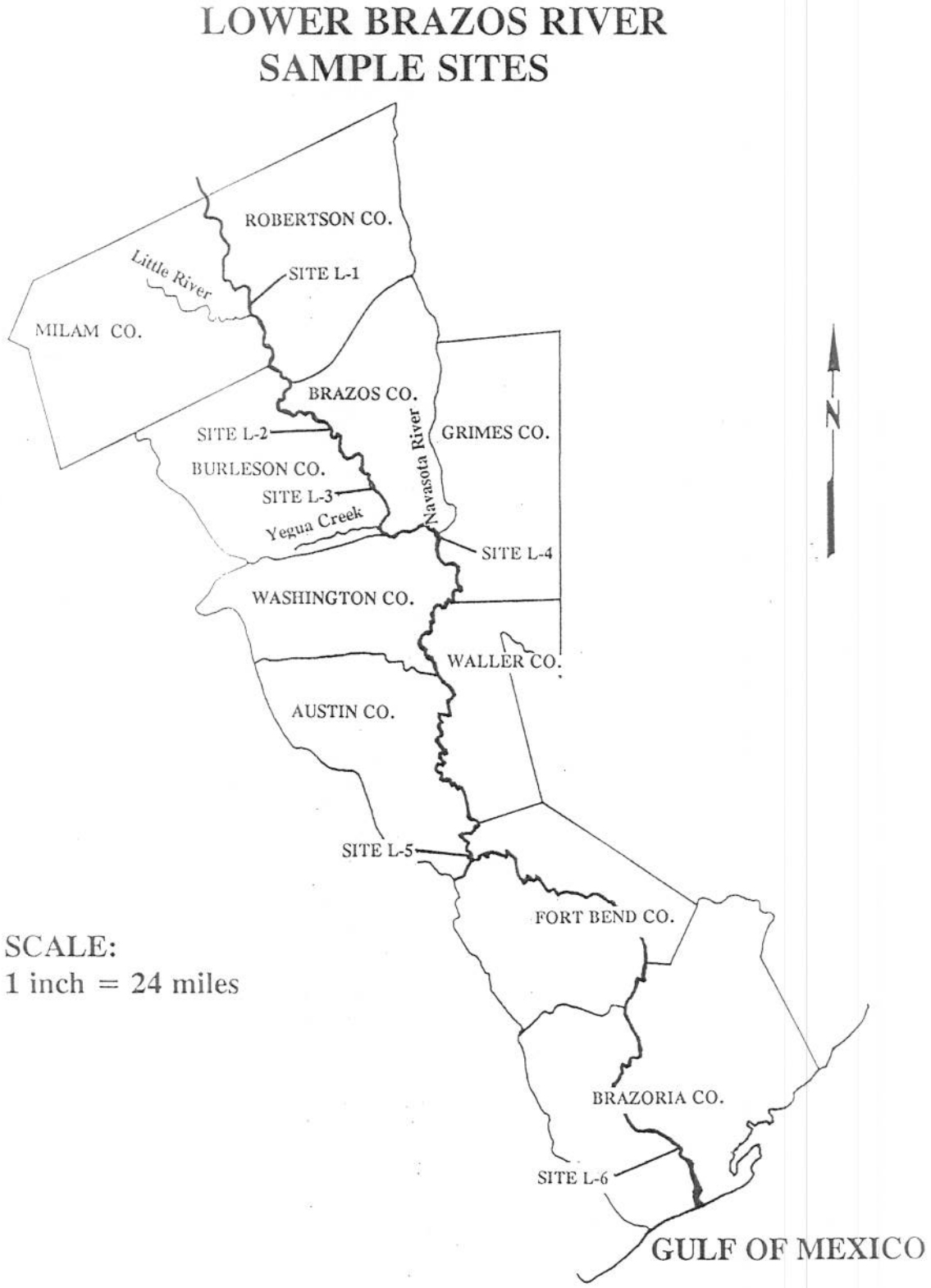

Figure 4. Location of sample sites on the lower Brazos River, Texas, 1994.

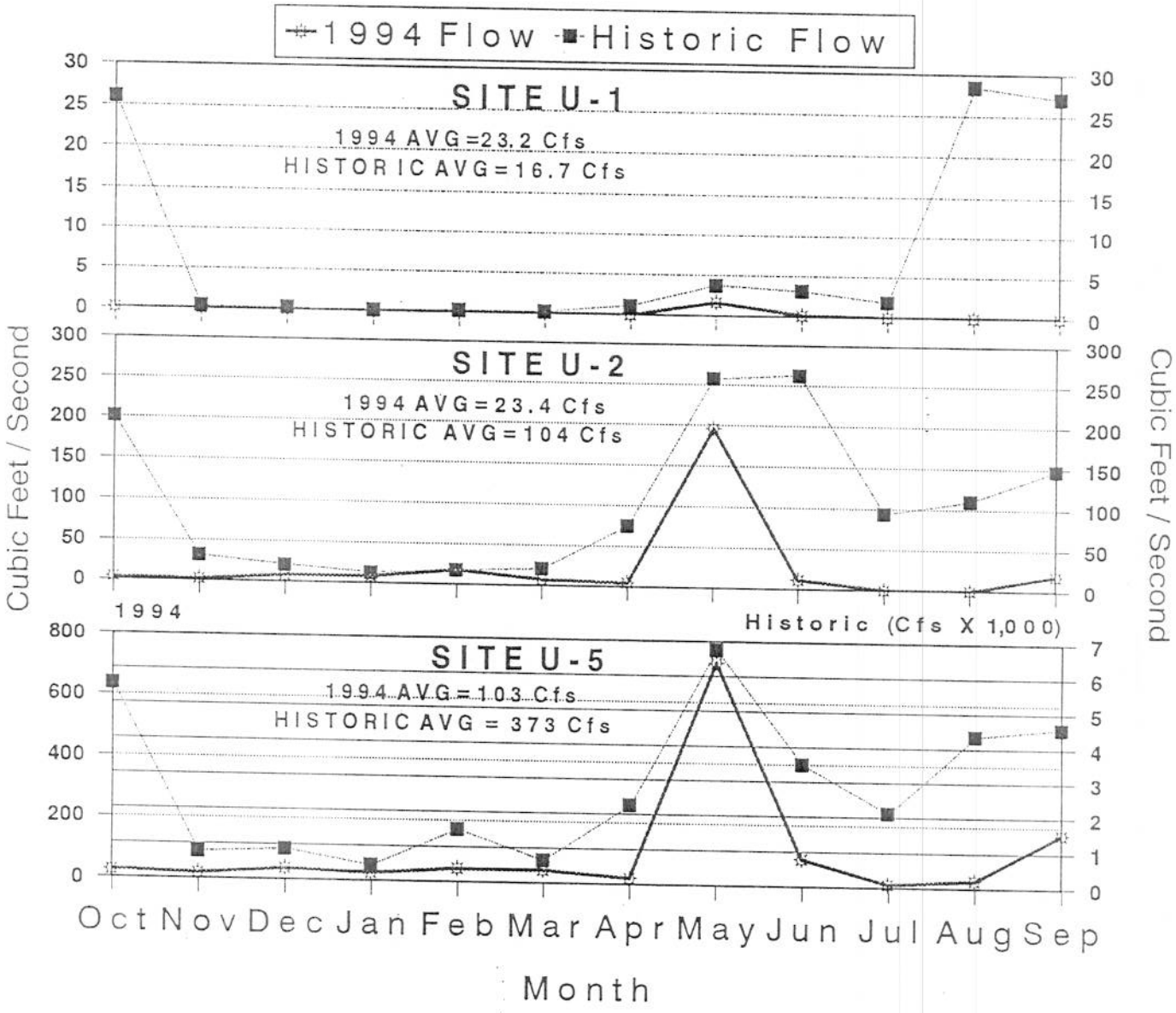

Figure 5. Flow data for the upper Brazos River, Texas, comparing mean flows in 1994 to historical flows. Data from U S Geological Survey guaging stations.

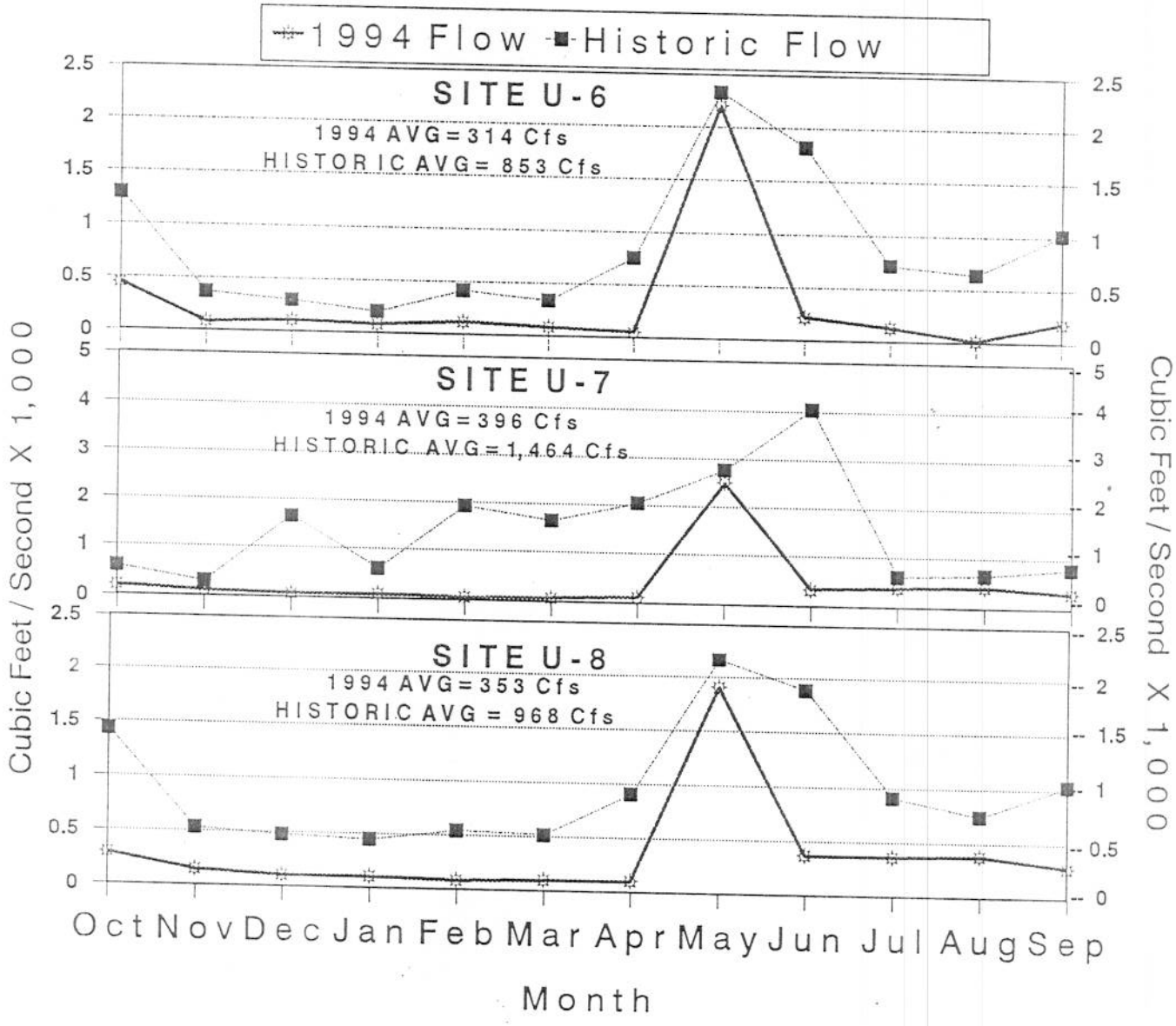

Figure 5. (Continued)

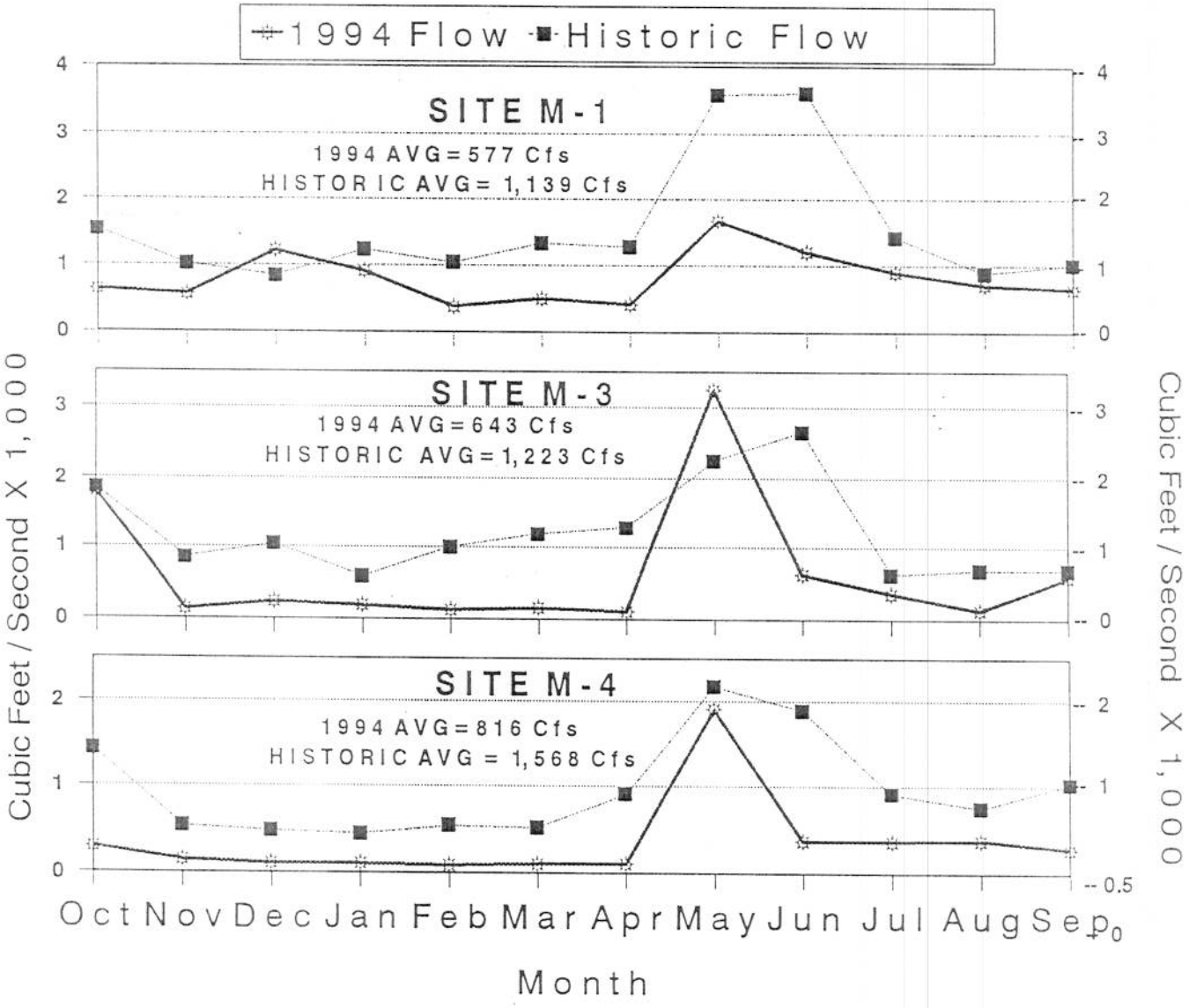

Figure 6. Flow data for the middle Brazos River, Texas, comparing mean flows in 1994 to historical flows. Data from U S Geological Survey guaging stations.

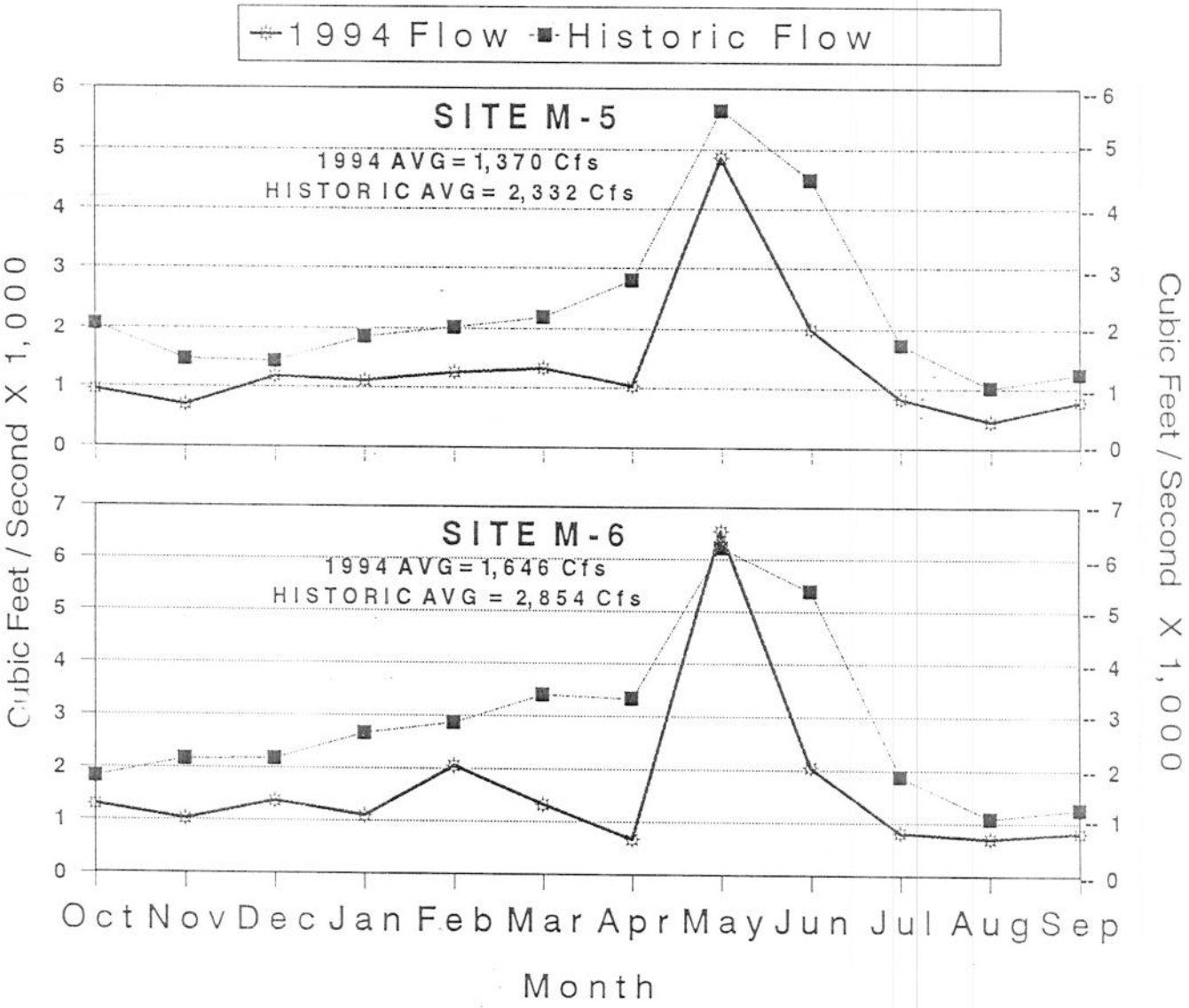

Figure 6. (Continued)

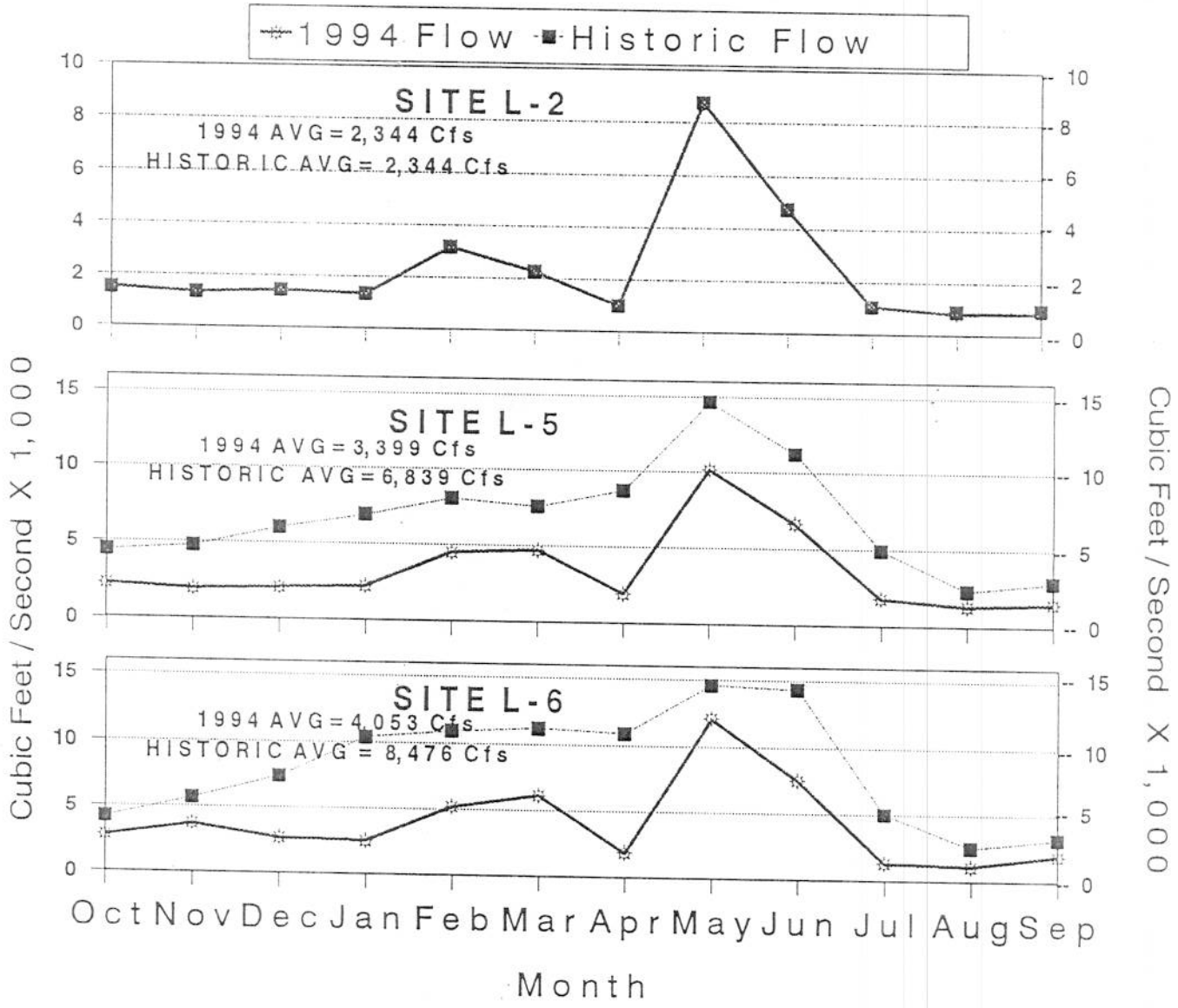

Figure 7. Flow data for the lower Brazos River, Texas, comparing mean flows in 1994 to historical flows. Data from U S Geological Survey guaging stations.

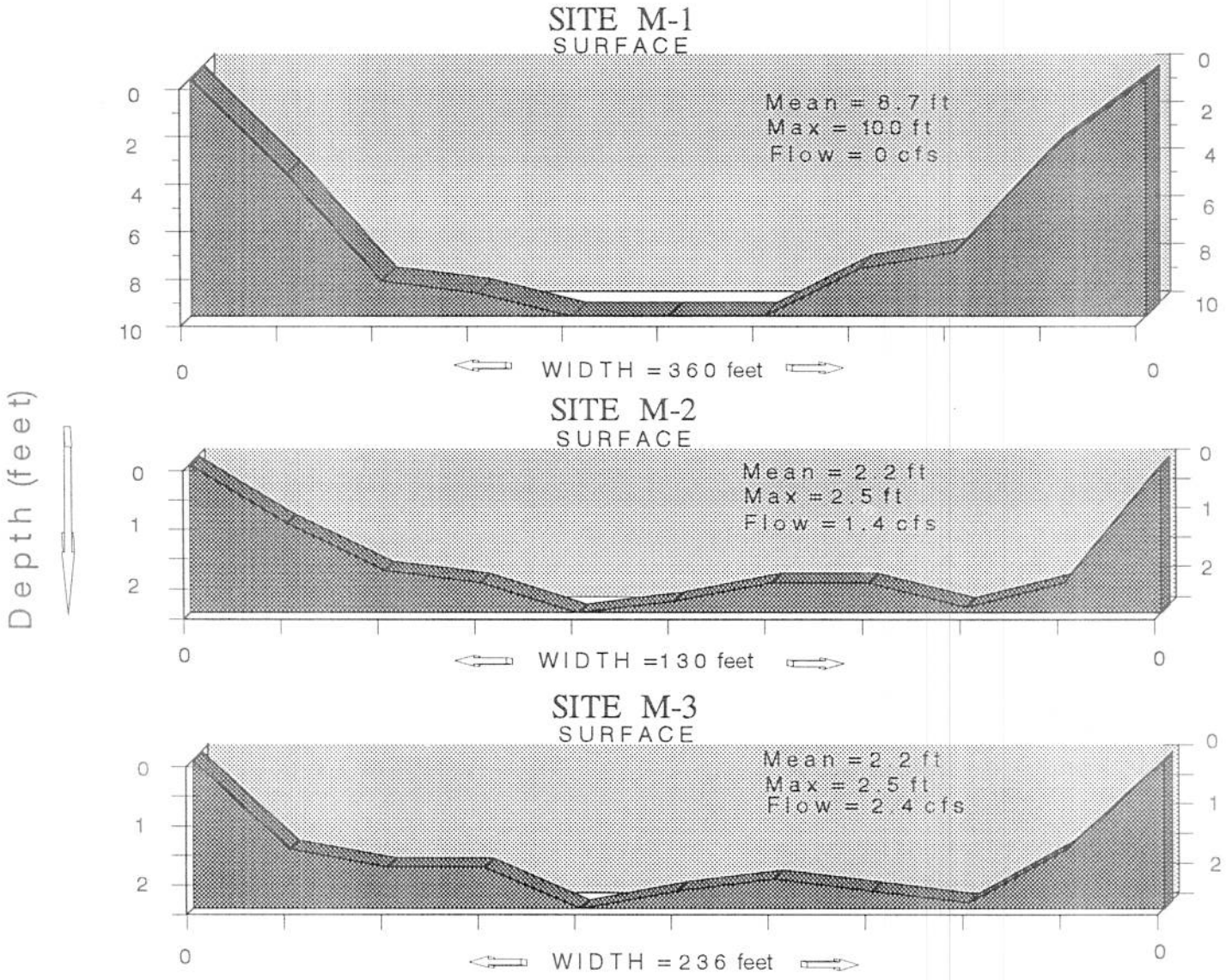

Figure 8. Depth profiles and flow estimates from sampling sites on the middle Brazos River, Texas, 1994.

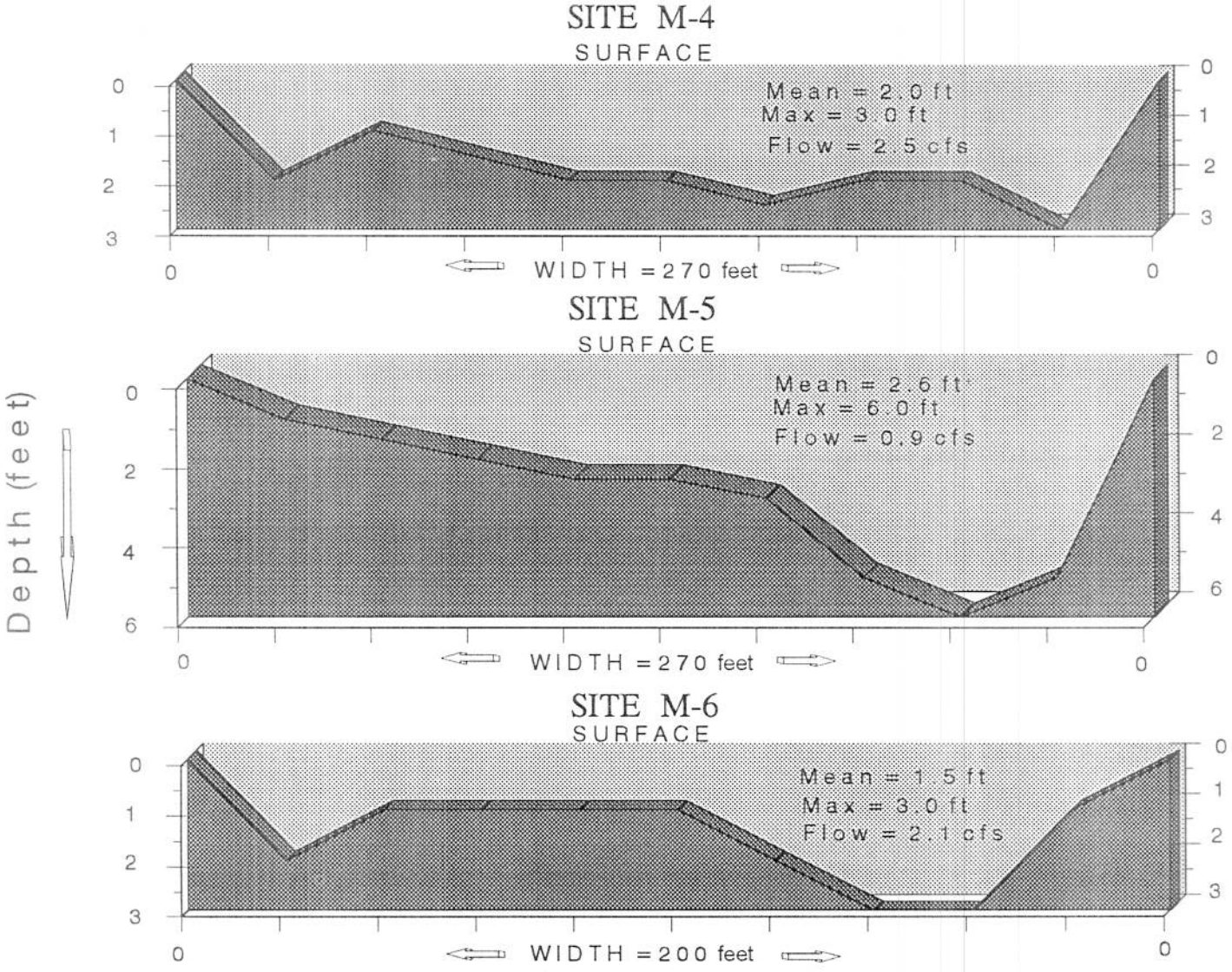

Figure 8. (Continued)

Appendix 1. Fisheries management plan for the Brazos River, Texas, 1994.

Goal

To develop and maintain the fisheries of the Brazos River for the anglers of Texas to provide the best outdoor recreational experience possible.

OBJECTIVE 1	Increase availability of public access to the Brazos River for all recreational activities.
PROBLEM	Public access is primarily limited to reservoir tailraces, a few highway crossings with inadequate boat launching facilities, and private campgrounds. Due to private ownership of river-front property, public access to the river is very limited.
STRATEGIES	Work with proper authorities to increase the number of public access locations and the number of improved launch ramps associated with highway bridges. Encourage local, county, or state agencies to install improved launch ramps, camp sites, and bank fishing areas between major highway crossings.
OBJECTIVE 2	Conduct future surveys to monitor fish populations.
PROBLEM	Standard survey procedures should be implemented as time permits to more closely monitor populations of fish and mussel species. Data is needed to protect existing species, set fish harvest regulations, and determine influences of pollution and angling.
STRATEGIES	Abundance and distribution of all fish and mussel species should be monitored during future surveys to determine changes in populations. Population structural indices, condition, growth rates, reproduction, and recruitment of sport fishes should be examined to determine appropriate fish harvest regulations.
OBJECTIVE 3	Conduct special investigations as pollution problems are revealed.
PROBLEM	In the past pollution problems have included illegal discharge of heavy

metals, illegal discharge of fill material, illegal construction within the streambed, illegal sand and gravel dredging, and various industrial and agricultural related influences.

STRATEGIES

Assist the Resource Protection Division in investigation of all observed or reported incidences of pollution in a timely manner. Educate land owners to make them aware of existing problems and ways they can help to reduce agriculture related pollution. Promote the establishment of riparian buffer zones to reduce negative effects of agricultural and industrial inflows.