

Brazos River File

PERFORMANCE REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

Federal Aid Project F-30-R-8

Statewide Fishery Management Recommendations

Job A: Existing Reservoir and Stream Management Recommendations

Brazos River, 1982

Robert L. Bounds
Inland Fisheries Management Program Director

District II-A
Bruce T. Hysmith
District Management Supervisor

Charles D. Travis
Executive Director
Texas Parks and Wildlife Department
Austin, Texas

Ernest G. Simmons
Chief, Inland Fisheries

Robert J. Kemp
Director of Fisheries

January 15, 1983

Performance Report
Job A, District II-A

Objective: To recommend habitat improvement, fisherman information, fish population manipulation, vegetation control, pollution control, fisherman access and facility development, and fishing regulations for existing and proposed public waters of Texas.

I. Summary: Twenty miles of the Brazos River below Possum Kingdom Reservoir, Palo Pinto County, Texas, was surveyed according to stream management manual procedures. Survey methods included water quality analysis, seining, gill netting, habitat and vegetation analysis, and assessing fisherman access and facilities.

Major sport fishes included rainbow trout, channel catfish, white bass, striped bass, sunfishes (Lepomis sp.), spotted bass, largemouth bass, and white crappie. Management recommendations included increased monthly minimum instantaneous flow from Morris Sheppard Dam and the introduction of smallmouth bass.

II. Significant Deviation: None.

III. Cost: \$13,000.00

IV. Prepared by:

Bruce T. Hysmith
District Management Supervisor

John H. Moczygomba
Assistant District Management Supervisor

Don B. Miller
Fish and Wildlife Technician

John R. Ballard
Fish and Wildlife Technician

Patrick W. Buchanan
Fish and Wildlife Technician

Date: January 15, 1983

Approved by:


Robert L. Bounds
D-J Management Coordinator

Roger L. McCabe
Assistant D-J Management Coordinator

DESCRIPTION OF STUDY AREA

The Brazos River is the third largest river in Texas (Pass 1981). It originates in west-central Texas as the Double Mountain, Salt, and Clear Forks of the Brazos, and flows southeasterly for approximately 840 mi to the Gulf of Mexico (Fig. 1). The river flows through most of the main land resource areas of the Texas-High Plains, Rolling Plains, North Central Prairies, Cross Timbers, Grand Prairie, Blackland Prairies, Central Basin, and Claypan Area, and drains about 42,800 mi².



This study was conducted on approximately 20 mi of the Brazos River in Palo Pinto County between Morris Sheppard Dam, which impounds Possum Kingdom Lake, and Farm-to-Market Road (FM) 4. The dam is controlled by the Brazos River Authority which produces power for the Brazos Electric Cooperative System. The area is confined to the North Central Prairies land resource area and included the major tributaries Garland, Ioni, Eagle, and Dark Valley Creeks. This section of the river is generally clear, has 13 major pools, numerous riffles, and many backwater flats. These physical features vary greatly with releases from the reservoir. At low flow (≤ 20 cfs) many of the riffles and backwater flats dry up. During periods of high flow ($\geq 1,000$ cfs) the river rises 2-3 ft. The streambed gradient is 2.7 ft/mi and depth ranges from 0.1 to 15 ft. Recreation is an important resource on this portion of the river.

Topography in this section ranged from moderately wooded and grassy hills to thickly wooded or cultivated bottomland. Cedar, mesquite, and native grasses predominated surrounding hills. Cottonwood, cedar, persimmon, salt cedar, willow, and native grasses were abundant along the shoreline, while the bottomland vegetation consisted primarily of pecan, cottonwood, oak, low shrubs, and native grasses. Mean annual rainfall in this immediate area is 28 in; in the headwaters of the Brazos River it is 16 to 20 in (Pass 1981).

METHODS AND MATERIALS

Sample stations were located at or near the confluence of each major tributary (Fig. 2) in compliance with Stream Survey Procedures, Texas Parks and Wildlife Department Management Survey and Reporting Procedures. Each of the four stations were sampled quarterly from April 1981 through February 1982. Water samples were collected from a pool at each station at the surface, mid-depth, and immediately off the bottom (Figs. 3, 5, 7, and 9). A YSI Model 51-A oxygen analyzer was used to measure temperature and dissolved oxygen (DO). A Leeds and Northrup 7417 portable meter was used to measure pH. Specific conductance was determined by a YSI Model 33 S-C-T meter. Total alkalinity, total hardness, turbidity, and chlorides were determined with a DR-EL Hach Portable Engineers Laboratory. Transparency was measured with a Secchi disc.

Depth, width, and current velocity were measured along a transect of a pool and of a riffle at each station (Figs. 3 through 9). A portable Lowrance Fish Lo-K-Tor or a yard stick was used to determine depth. A steel tape was used to obtain channel width. Current velocity was measured with a General Oceanics Model 2030 digital flow meter. Historical flow data were obtained from the Brazos River Authority. Substrate composition was determined from samples collected with a Wildco Model 196 bottom dredge along the same transects. The percent of stream in pools, riffles, and flats was noted.

Condition of fish habitat was noted and recorded during all collection trips. Bottom types, littoral zone development, abundance of aquatic vegetation, canopy density, and abundance of submerged cover (boulders or log-jams) were criteria for identifying fish habitat improvement needs. Species composition and distribution of aquatic vegetation were determined each trip. Aquatic vegetation was identified according to Fassett (1940) and Correll and Correll (1975).

Fish community was sampled with seines and gill nets. Seine collections were made in pool and riffle habitats at each station with a 26-ft bag seine constructed of 0.25-in nylon mesh. An estimated 2,500 ft² of stream bottom was sampled at each site. Samples were preserved in 10 percent formalin for subsequent identification and enumeration. Pool habitat at each station was sampled with a single gill net set per trip. Monofilament gill nets 200-ft long and 8-ft deep were used. Mesh size increased by 0.50-in increments from 0.50- to 4-in at 25-ft intervals. Total catch was sorted, counted, and bulk weighed by species. Species identification followed Anon. (1968) and Eddy (1969). Common and scientific names used in this report were in accordance with Robins (1980). Individual weight and total length (TL) and stomach contents were recorded for selected species of sport fish.

Scale samples were collected from white bass for age determination. Pectoral spines were taken from channel catfish for age and growth analysis. Information recorded with each scale and spine sample included: (1) sex, (2) TL in mm, and (3) weight in g. Scales were pressed on acetate slides and examined with a Bauch and Lomb Tri-simplex microprojector. Each scale was analyzed for the presence of annuli and the age of each fish was then noted. Spine samples were sent to the Texas Parks and Wildlife Department Heart-of-the-Hills Research Station for age determination and growth computation. Length-weight relationships for channel catfish were calculated by using the model:

$$\text{Log}_{10} \text{ Weight (g)} = a + (b) \text{Log}_{10} \text{ Length (mm)}.$$

Where:

a = intercept of the regression
b = slope of the regression.

Coefficient of condition (K) was calculated using the following formula:

$$K = \frac{W 10^5}{L^3}.$$

Where:

W = weight in g
L = length in mm.

Public access and fisherman information needs were evaluated by determining if existing facilities and sources of information were adequate to support optimum utilization of the fishery resource.

Fish population information was used to determine needs for changes in harvest regulations.

RESULTS AND DISCUSSION

Physicochemical Characteristics

Data collected in this study show water quality in this section of the Brazos River will sustain fish life (Tables 1 and 2; Swingle 1949, Brown 1957, Lee 1971, and Bardach et al. 1972). However, the data do not illustrate the effects of hydroelectric generation on water temperature and flow regimes. Zimmerman et al. (1980) reported temperature fluctuations of 12-13 F per 24 hours in this section of the Brazos River during April, 1979 due to discharge. Depending on the frequency of occurrence, abrupt changes in temperature could alter spawning patterns, and affect egg incubation and/or fry development of fish fauna (Walburg et al. 1981 and Hubbs 1972).

Fish Habitat

Fish habitat in this section of the Brazos River included a stream bed of muck, detritus, clay, silt, sand, gravel, rubble, bed rock, and boulders. Primarily, muck, detritus, and clay were found in the lower stations farthest from the dam except for a portion about 1.5-2 mi upstream from FM 4 which was scoured bedrock. Since Possum Kingdom Reservoir acts as a sediment trap, the river immediately below the dam was clear, and had a stream bed composed primarily of gravel and rubble.

The pool:riffle:flat ratio was 5:4:1. The pools were from 80 to 400 ft wide and had a 2.1-8.3 ft average depth (Table 2). Boulders and rocky bluffs in most of the pools provided cover for flathead and channel catfish, largemouth and spotted bass, and other sport fishes (Fig. 10). Shallow pools and backwater areas provided suitable spawning habitat for sport fishes (Fig. 10). The riffles with their dense growth of algae, pondweed, water star-grass, and sago pondweed provided habitat for a variety of forage fishes and invertebrates. Nursery areas were provided by riffles and backwaters.

There were no areas on the river where there was a complete canopy, but partially shaded areas provided by black willow, cottonwood, oak, elm, cedar, and salt cedar trees extended 10 ft from the bank in many areas. Eleven species of aquatic vegetation were encountered during the survey (Tables 3 and 4). None were considered problematic.

The most limiting factor for habitat seems to be volume of flow. Variation in flow regimes alters fish habitat and water quality (Neel 1963, Walburg et al. 1981). Water level fluctuates about 2-3 ft (Figs. 3 and 10) in this section of the Brazos River as a result of normal hydroelectric power generation. During low discharge (9-20 cfs), most riffles and many backwater flats, or approximately 49 percent of this section, is dewatered (Fig. 11). Monthly median flow from Morris Sheppard Dam for 1978-1981 varied from 20 to 2,393 cfs (Fig. 12). Flow-frequency distribution (Fig. 13), based on discharge from Morris Sheppard Dam, indicated over one-half (53 percent, 774 days) of the time during 1978-1981 (1,461 days) flow was ≤ 20 cfs; hence, a four-year median flow slightly less than 20 cfs. Therefore, from 1978-1981, 49 percent of the stream habitat was dewatered 53 percent of the time. A condition which our data indicated was insufficient to maintain adequate sport fish production.

Insect Community

Numerous insect larvae (Trichoptera, Diptera, and Ephemeroptera) were observed during collections at all stations. Cloud and Stewart (1974a and 1974b) reported 30-40 species of insect fauna in riffle communities of this section of the river. Sport fishes were observed feeding at the surface on adult mayflies. These insects were an important food source in the river as reported by Forshage (1972).

Fish Community

Forage Fishes: The most predominant forage species were red shiner, blacktail shiner, and inland silverside (Table 5). Threadfin shad were collected in spring during their spawning run, but apparently were not abundant in this section of the river during the rest of the year. Gizzard shad were found during all seasons, but were generally too large (average TL = 11 in) to be used except by the largest predators (flathead catfish and striped bass). Other species of forage included bullhead minnow, mosquitofish, and small bluegill and longear sunfish.

Sport Fishes: Sport fishes comprised 28 percent of the fish community in the study area. Relative abundance of sport fishes ranged from 18 percent in April to 37 percent in February (Tables 6 through 9). While there was seasonal variation in total gill net catches, the numbers of sport fishes remained fairly stable. Predominant sport fish included channel catfish and white bass. Other sport fishes collected were flathead catfish, striped bass, white bass x striped bass hybrid, sunfishes (Lepomis sp.), spotted bass, largemouth bass, and white crappie.

Channel catfish was by far the most frequently collected sport fish comprising 18 percent of total catch and 63 percent of sport fishes (Fig. 13). They were found most often at Stations 1 and 2 which were closest to the dam. According to Walburg et al. (1981) they were often abundant in the warm tailwaters of turbid main-stem or tributary rivers, but are uncommon or absent in clear, cold tailwaters. Two reasons for this non-conforming behavior in the Brazos River could be better habitat and greater abundance of preferred food. Generally, upstream from station 3, the river is characterized by deeper pools, shorter riffles, and a greater abundance of green algae than below Station 3. Seasonal mean weight varied from 2.8 lb in the spring to 1.1 lb in the winter with an overall mean of 1.5 lb (Tables 6 through 9).

Growth of channel catfish in the Brazos River (Table 10) was equal to or faster than growth in other waters (Table 11). Length weight regression was

computed to be:

$$\text{Log}_{10} \text{ Weight (g)} = -6.4 + 3.6 \text{ Log}_{10} \text{ Length (mm)}.$$

The calculated slope of the length-weight regression (3.6) was compared (t-test) to isometric growth (3.0). Channel catfish in the Brazos River grow significantly ($P < 0.01$) faster in weight than in length. Good growth was further substantiated by an excellent K of 1.278 which was greater than the range of mean K (0.75-1.12) reported by Carlander (1969).

Seining did not indicate an abundance of young-of-the-year (YOY) channel catfish (Table 5) which suggested low reproduction. Recruitment since 1978 has apparently been low to non-existent as no Age I and II fish were collected (Table 10).

Channel catfish are omnivorous (Carlander 1969 and Miller 1966) and in this study green algae (Chlorophyceae) was the predominant food item; occurring in 79 percent of the 56 fish stomachs examined. Frequency of occurrence for unidentified fish remains was 16 percent, and 13 percent for insects.

Flathead catfish did not appear in the study area until spring and summer (Tables 6 through 9) and then only in the lower sections (Fig. 14). Mean weight was 7.9 lb.

White bass were found throughout the study area (Fig. 14), but were absent in spring gill net collections (Tables 6 through 9). Contrary to angler reports, our data indicated white bass were low in abundance. Although YOY white bass were not collected, the presence of ripe females and flowing males in December suggested a reproducing population. White bass may be recruited from Lakes Possum Kingdom and Granbury. Mean weight of white bass was 0.75 lb and the oldest fish collected was Age II.

Angler catches of striped bass have been reported throughout the study area. Our data, however, indicates these fish concentrate in the upper portion nearest the tailrace (Tables 6, 7, and 8). Mean weight of striped bass caught in gill nets averaged 4.2 lb.

Spotted bass, largemouth bass, and white crappie were extremely low in abundance in this section of the Brazos River (Tables 6, 7, and 9; Fig. 14). YOY spotted and largemouth bass were collected during the summer in Dogleg Riffle at Station 3. YOY spotted bass were more abundant than YOY largemouth bass (Table 5). YOY white crappie were not collected. Sunfishes collected included bluegill, longear sunfish, and green x longear sunfish hybrids (Tables 6 through 9).

Rough Fishes: Rough fish were not considered problematic. Smallmouth buffalo were the most frequently collected rough fish (Tables 6 through 9; Fig. 15). Less common were carp and river carpsucker. Golden redhorse were captured during February.

In general, our data indicated a single-species (channel catfish) sport fishery in this segment of the Brazos River. The reduction of habitat caused by low stream flow, and extreme fluctuation in water temperature can

limit the abundance of many sport fish species (Neel 1963, Hubbs 1972, and Walburg et al. 1981). Certainly forage did not appear to be a problem since this portion of the river contained an abundance of minnows and insect larvae (Cloud and Stewart 1974a and 1974b and Zimmerman et al. 1980). Seasonal and flow-induced immigration of white and striped bass, and the introduction of catchable rainbow trout in the tailrace below Morris Sheppard Dam during November - March, provides a temporary enhancement to the fishery. However, we feel the existing sport fishery should be permanently enhanced to provide year-round fishing.

Public Access and Facilities

Public access to this section of the Brazos River is limited to a 1 mi portion of the river between Morris Sheppard Dam and the Texas Highway 16 bridge and the FM 4 bridge crossing. There are numerous private access points and access can be gained in many cases with permission of the land owner. The only facility is a small camp area with toilets provided by the Brazos River Authority immediately below the Morris Sheppard Dam. Canoe and float trip enthusiasts utilize the river frequently between March and October. Heavy use of the area near the Texas Highway 16 bridge coincides with our "put-and-take" rainbow trout program. Although trash recepticals are provided near the highway 16 bridge access, toilet facilities are not available. Throughout the year other anglers utilize the tailrace and the large pool adjacent the Possum Kingdom State Fish Hatchery, especially for white bass and striped bass.

Fisherman Information

Due to the "put-and-take" rainbow trout fishery and the use of the Brazos River by canoeists and float trip enthusiasts, the recreational and fishing opportunities on the river are well known within a 100-mi radius. Dallas-Fort Worth Metroplex and local news papers publicize angler catches and rainbow trout stocking.

Fish Harvest Regulations

Changes in fish harvest regulations in this section of the Brazos River are not needed.

MANAGEMENT RECOMMENDATIONS

Physicochemical Characteristics

To alleviate the abrupt temperature changes and the high water level fluctuation in the study area, minimum flow should be increased (Table 12). According to Lyons (1979) recommended monthly minimum flow in this section of the Brazos River (U.S.G.S. Station No. 08089000, at FM 4, Palo Pinto County, Texas) should vary from 42-403 cfs with maximum flow occurring May-September. Our recommended monthly minimum instantaneous flow (discharge) at the Morris Sheppard Dam (Table 12) is based on an average between an upstream monthly minimum instantaneous flow and a downstream monthly minimum instantaneous flow. This average flow was selected to compensate for non-recorded inflow from tributaries between the U.S.G.S. gaging station at South Bend, Texas and Morris Sheppard Dam, and for the influence of runoff from tributaries between the dam and the U.S.G.S. gaging station at FM 4.

Fish Habitat

An increase in monthly minimum instantaneous flow (Table 12) in this section of the Brazos River would allow for increased sport fish production by reclaiming all or a portion of the estimated 49 percent of the stream course dewatered during low flow (≤ 20 cfs). At the recommended flows an estimated 85 to 100 percent of the stream course would be watered most of the time, as opposed to 51 percent under current flow regimes (1978-1981).

Fish Community

The sport fishery in this section of the Brazos River would be enhanced through the implementation of recommended flow regimes. Additionally, the introduction of smallmouth bass would further enhance the fishery through increased species diversity. Smallmouth bass prefer a stream with a gravel or rocky bottom, clear, cool water, riffles, boulders, and pools over 4-ft deep (Emig 1966). In spite of extreme fluctuations in water temperature, this section of the river meets most of these requirements. Smallmouth bass might prove more suitable than native black basses to the existing environment. Because of increased utilization and public interest, the annual rainbow trout "put-and-take" stocking program should be continued.

Public Access and Facilities

Existing access and facilities are generally adequate for present public usage, however, chemical toilets should be installed at the high use area near the Texas Highway 16 bridge.

Fisherman Information

Fisherman information should be publicized through local and Dallas-Fort Worth Metroplex newspapers.

Fish Harvest Regulations

Existing fishing regulations are adequate at this time; therefore, no recommendations are made.

ACKNOWLEDGEMENTS

The authors wish to thank Messrs. Curtis Mitchell, Lloyd McCoy, Charles Overton, and H. L. Rochelle across whose land we gained invaluable access to certain sections of the river.

We also wish to recognize John Garland, Brazos River Authority, and Tom Cloud and Ed Lyles, U. S. Fish and Wildlife Service, for providing discharge records and stream flow data.

A special thanks to Texas Parks and Wildlife Department Game Wardens Wayne Chappell and Rick Medford for their assistance throughout this study.

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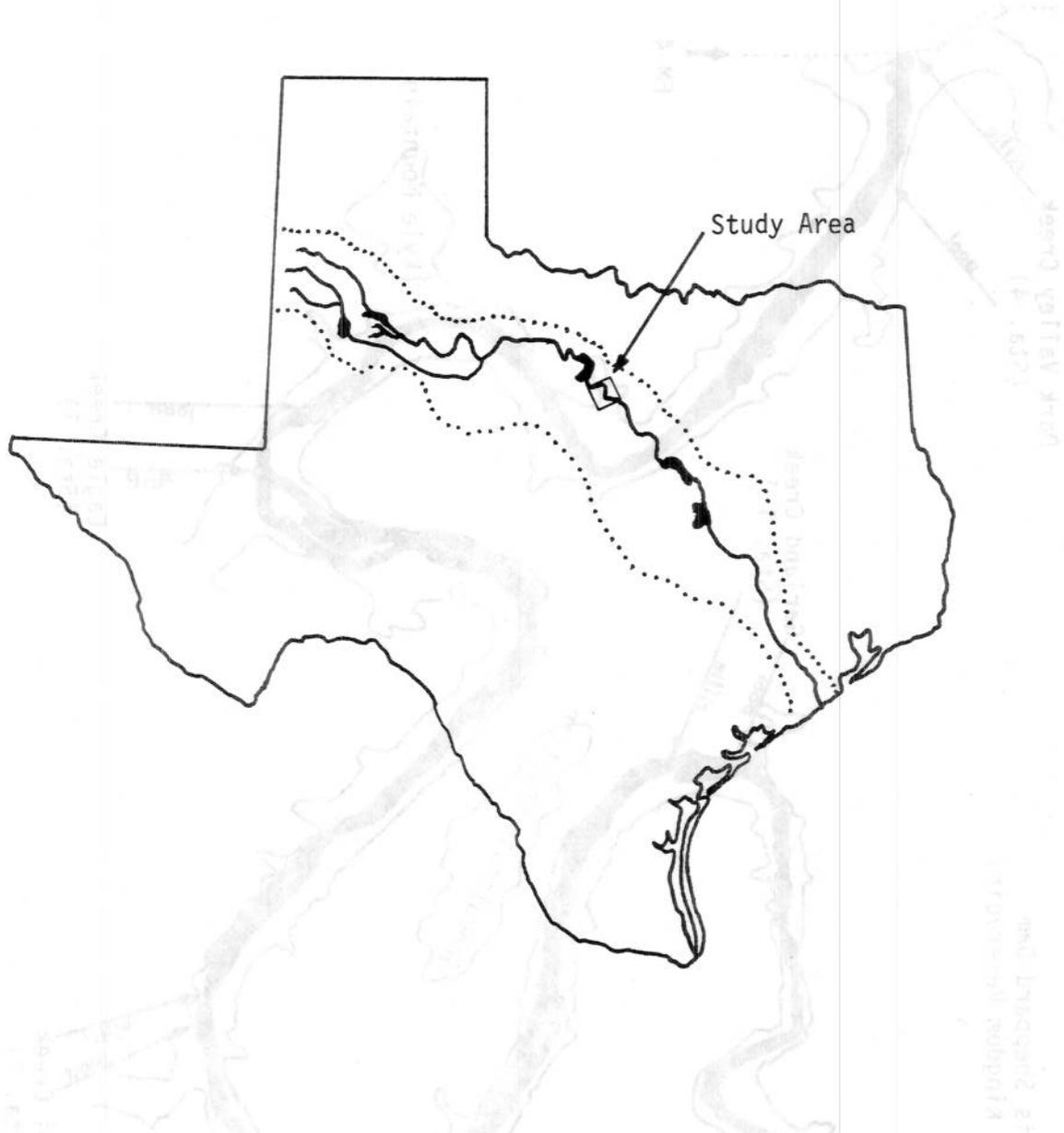


Figure 1. Brazos River and drainage basin, Texas, 1981-82.

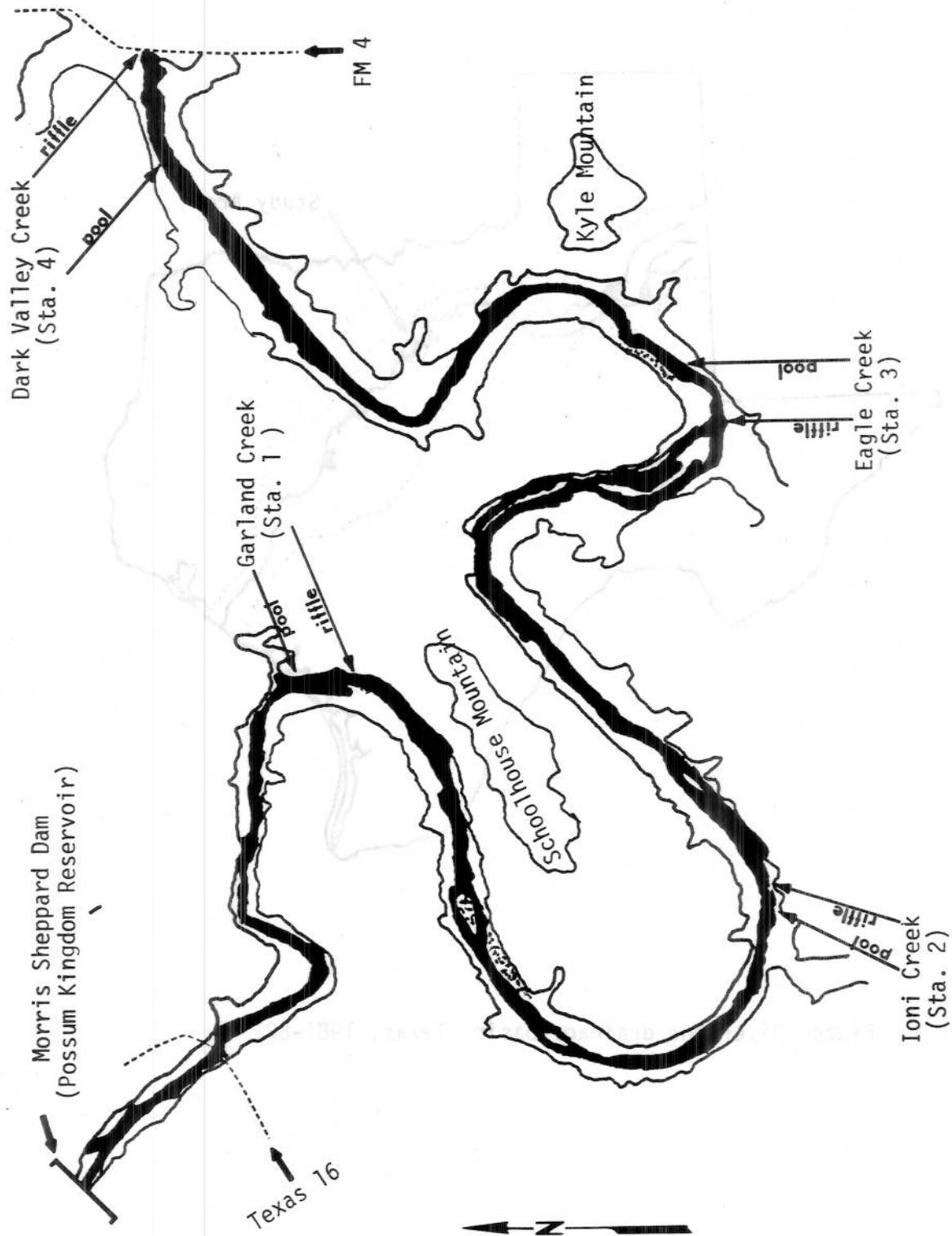


Figure 2. Location of sample stations in a 20-mile segment below Possum Kingdom Reservoir, Brazos River, Palo Pinto County, Texas, 1981-82.



Figure 3. Station 1, pool habitat at low flow (discharge ≤ 20 cfs), Brazos River at the confluence of Garland Creek, Palo Pinto County, Texas, February, 1982. Note the water mark on the sand bar in the center. (TPWD Photo: J. R. Ballard)



Figure 4. Station 1, riffle habitat at low flow (discharge ≤ 20 cfs), Brazos River at Pipeline Shoot below Garland Creek, Palo Pinto County, Texas, February, 1982. (TPWD Photo: J. R. Ballard)



Figure 5. Station 2, pool habitat at low flow (discharge ≤ 20 cfs), Brazos River at the confluence of Ioni Creek, Palo Pinto County, Texas, February, 1982. (TPWD Photo: J. R. Ballard)



Figure 6. Station 2, riffle habitat at low flow (discharge ≤ 20 cfs), Brazos River below the confluence of Ioni Creek, Palo Pinto County, Texas, February, 1982. Note the exposed and partially exposed stream bed to the left and in the background. (TPWD Photo: J. R. Ballard)

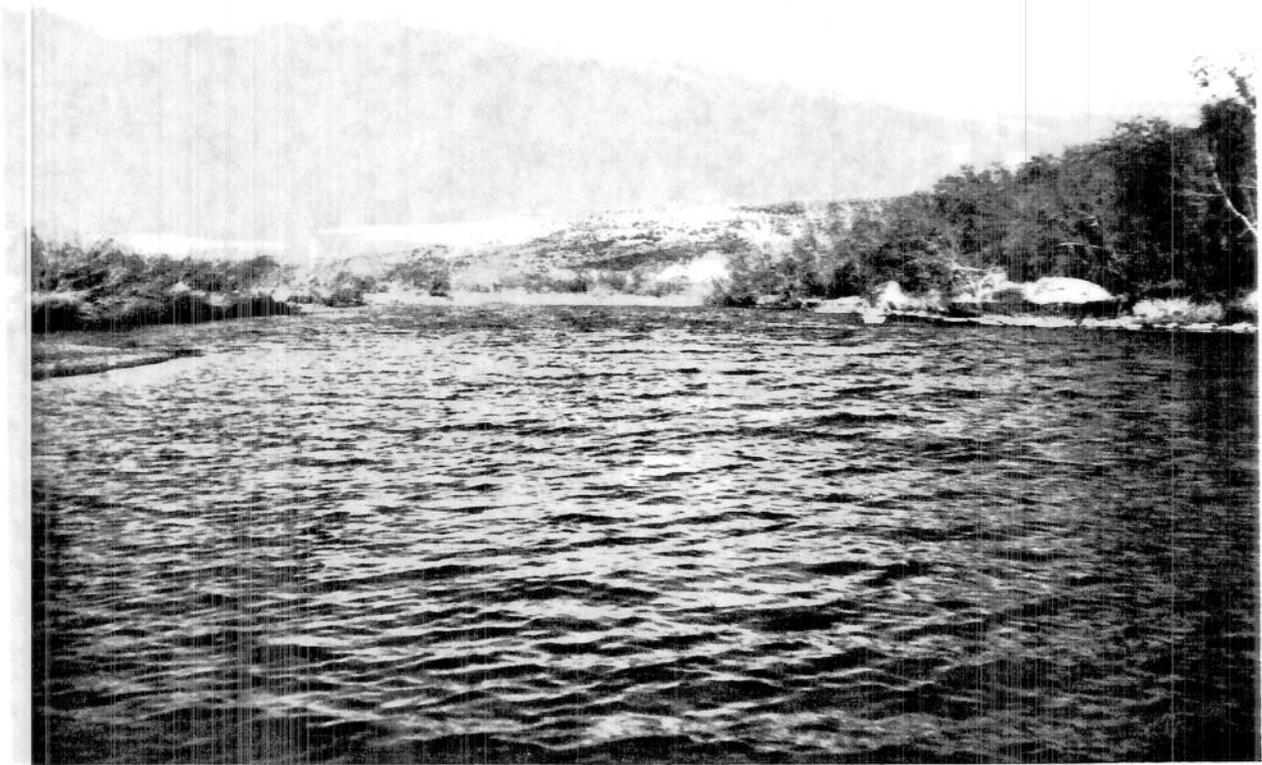


Figure 7. Station 3, pool habitat at low flow (discharge ≤ 20 cfs), Brazos River below the confluence of Eagle Creek, Palo Pinto County, Texas, February, 1982. (TPWD Photo: B. T. Hysmith)

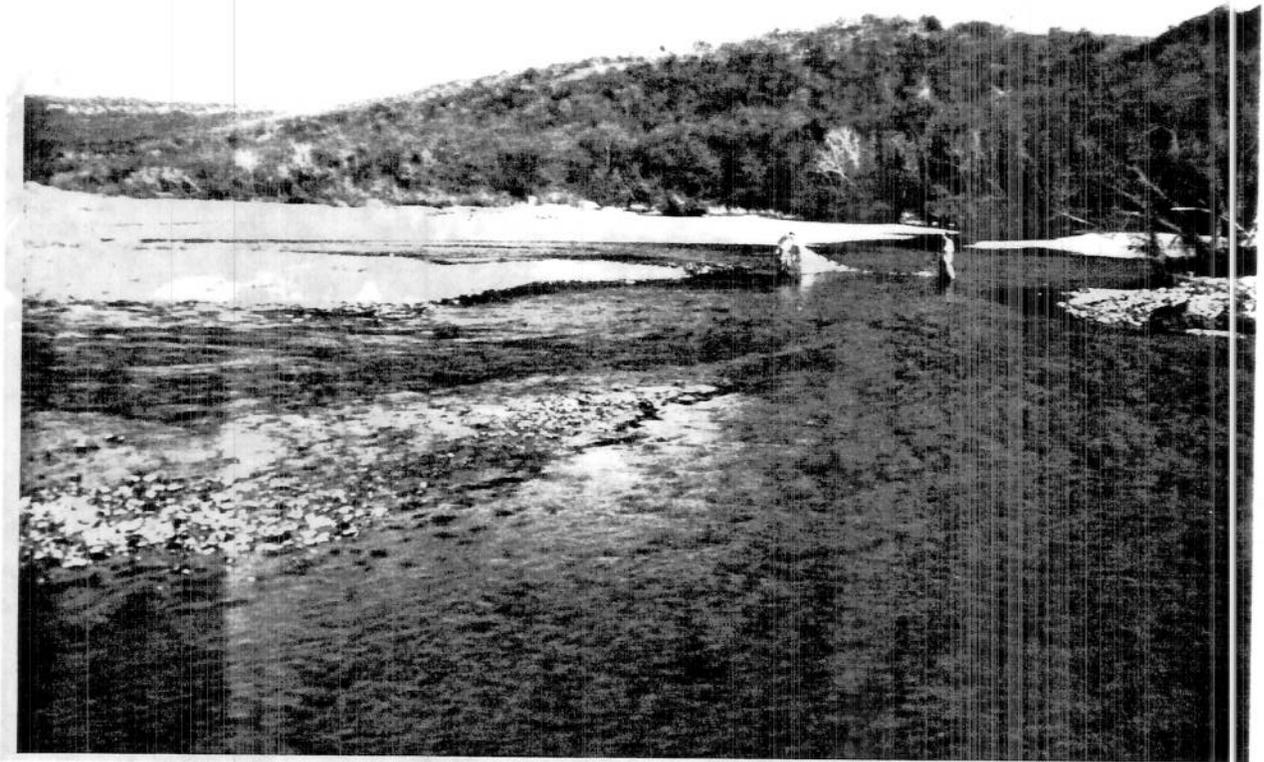


Figure 8. Station 3, riffle habitat at low flow (discharge ≤ 20 cfs), Brazos River at Dogleg Riffle below the confluence of Eagle Creek, Palo Pinto County, Texas, February, 1982. Note the exposed and partially exposed stream bed. Stream width at this point and at this time was less than one-half the width during discharge (351 cfs). (TPWD Photo: J. R. Ballard)

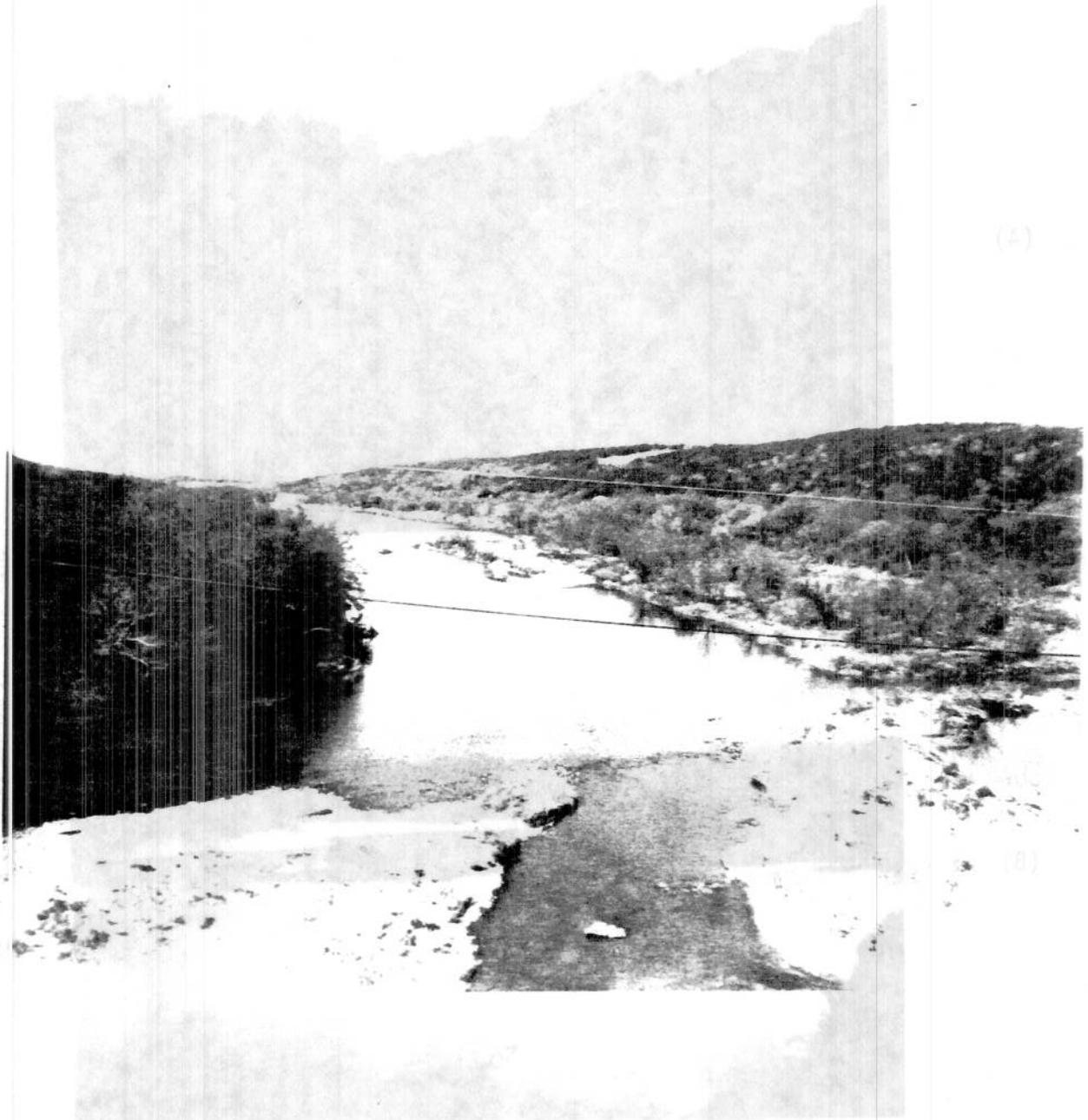
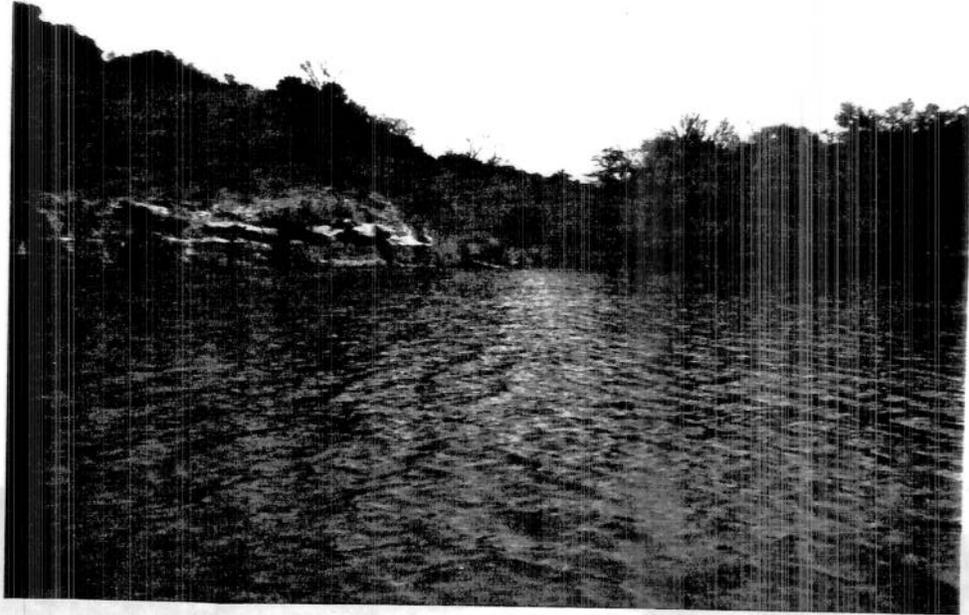


Figure 9. Station 4, pool habitat (upper center) and riffle habitat (lower left and center) during low flow (discharge ≤ 20 cfs), Brazos River at the confluence of Dark Valley Creek, Palo Pinto County, Texas, February, 1982. Note the exposed streambed to the left. About one-half of the riffle is dewatered. (TPWD Photo: B. T. Hysmith)

(A)



(B)



Figure 10. Fish habitat represented by boulders and rocky bluffs (A) and backwaters (B) at low flow (discharge = 20 cfs), Brazos River, Palo Pinto County, Texas, February, 1982. Note the water-mark on boulders in (A) and the exposed gravel bar in (B). (TPWD Photos: B. T. Hysmith and J. R. Ballard)

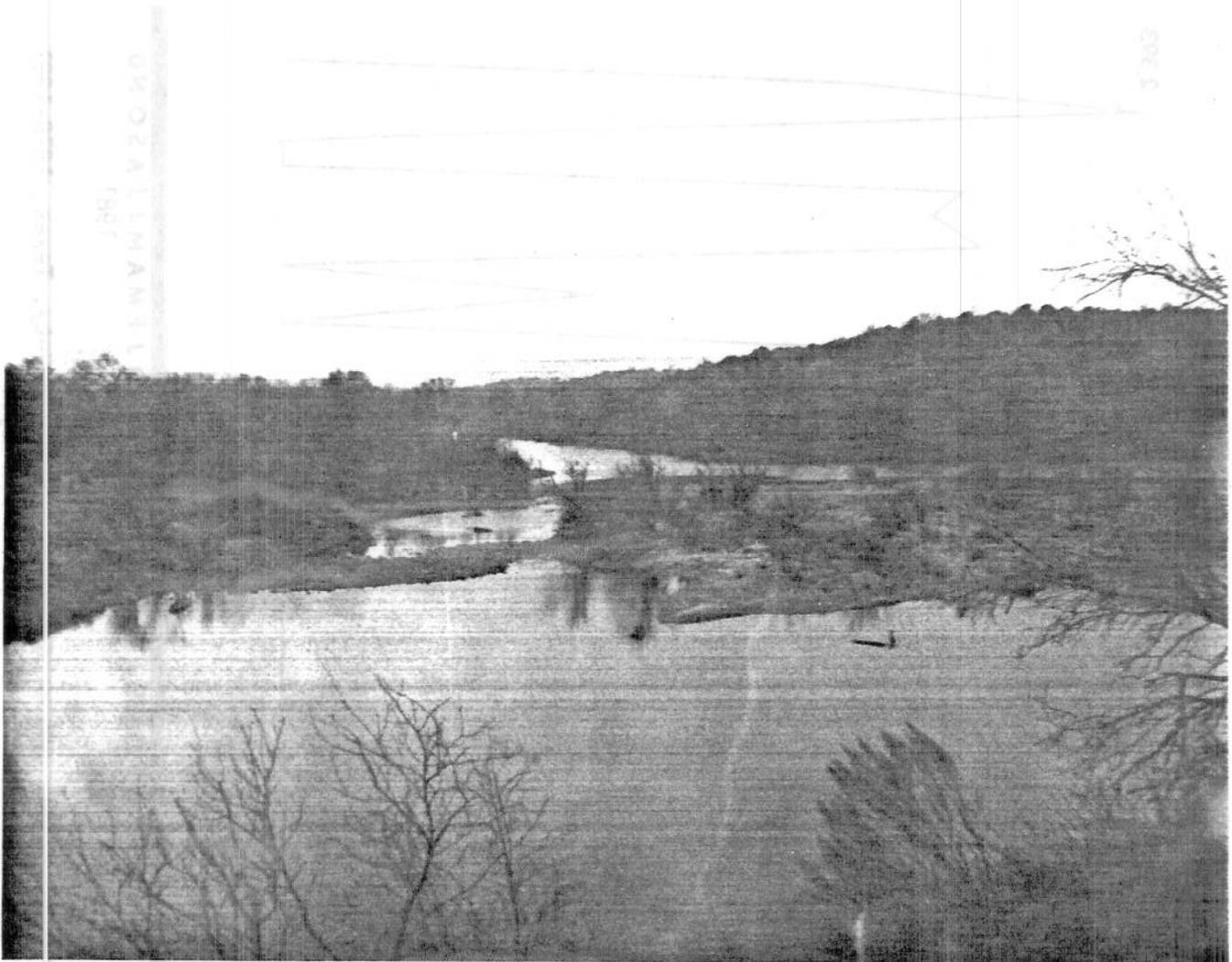


Figure 11. Upstream of Station 2 at the confluence of Ioni Creek (center) during low flow (discharge ≤ 20 cfs), Brazos River, Palo Pinto County, Texas, February, 1982. Note the dewatered riffle to the left and exposed stream bed in the background. During discharge (351 cfs) water from the Brazos River backs up into Ioni Creek and flows across the exposed riffle. (TPWD Photo: J. R. Ballard)

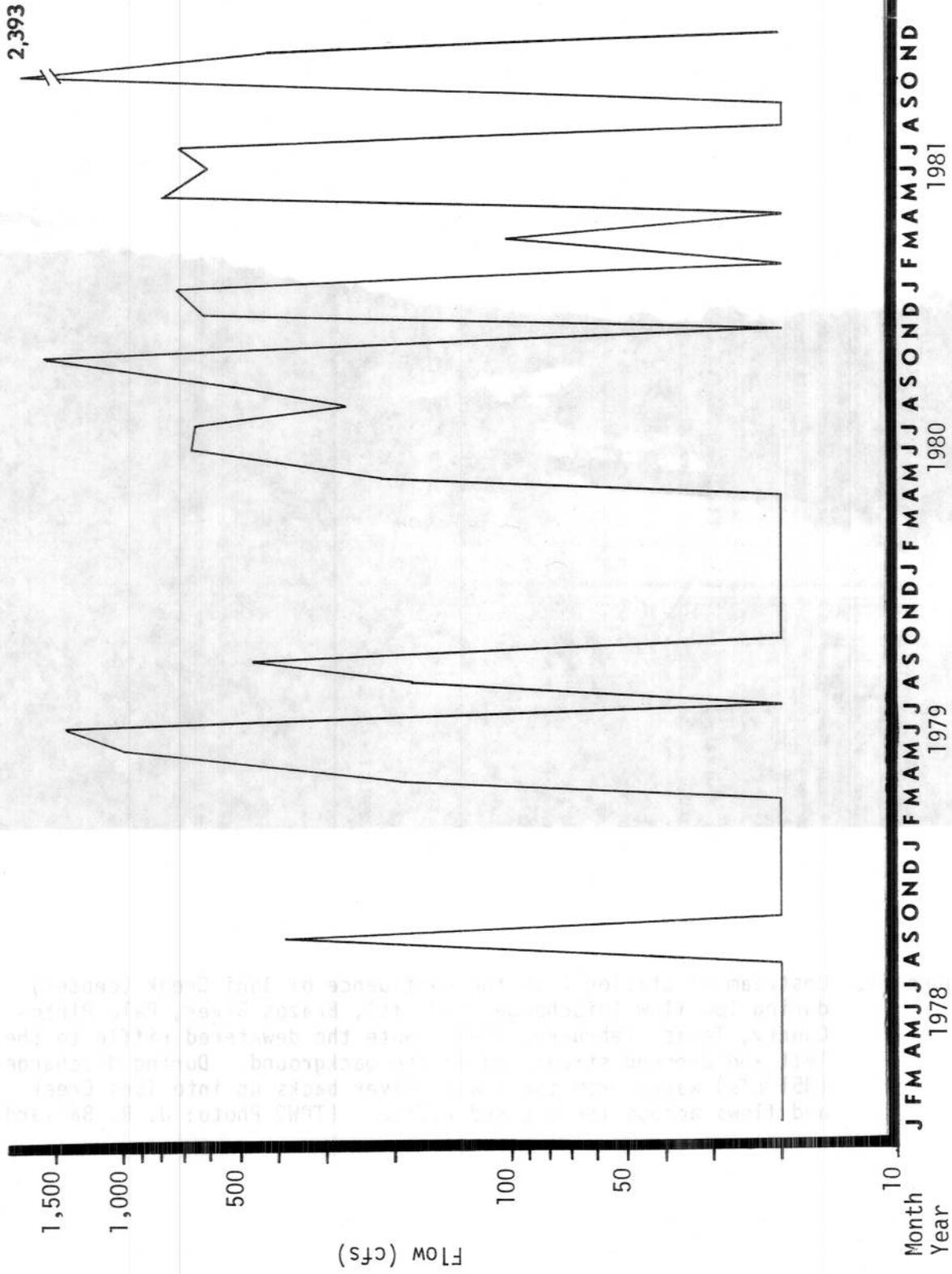


Figure 12. Monthly median flow (cfs) from Morris Sheppard Dam, Palo Pinto County, Texas, 1976-1981. Water release records obtained from the Brazos River Authority.

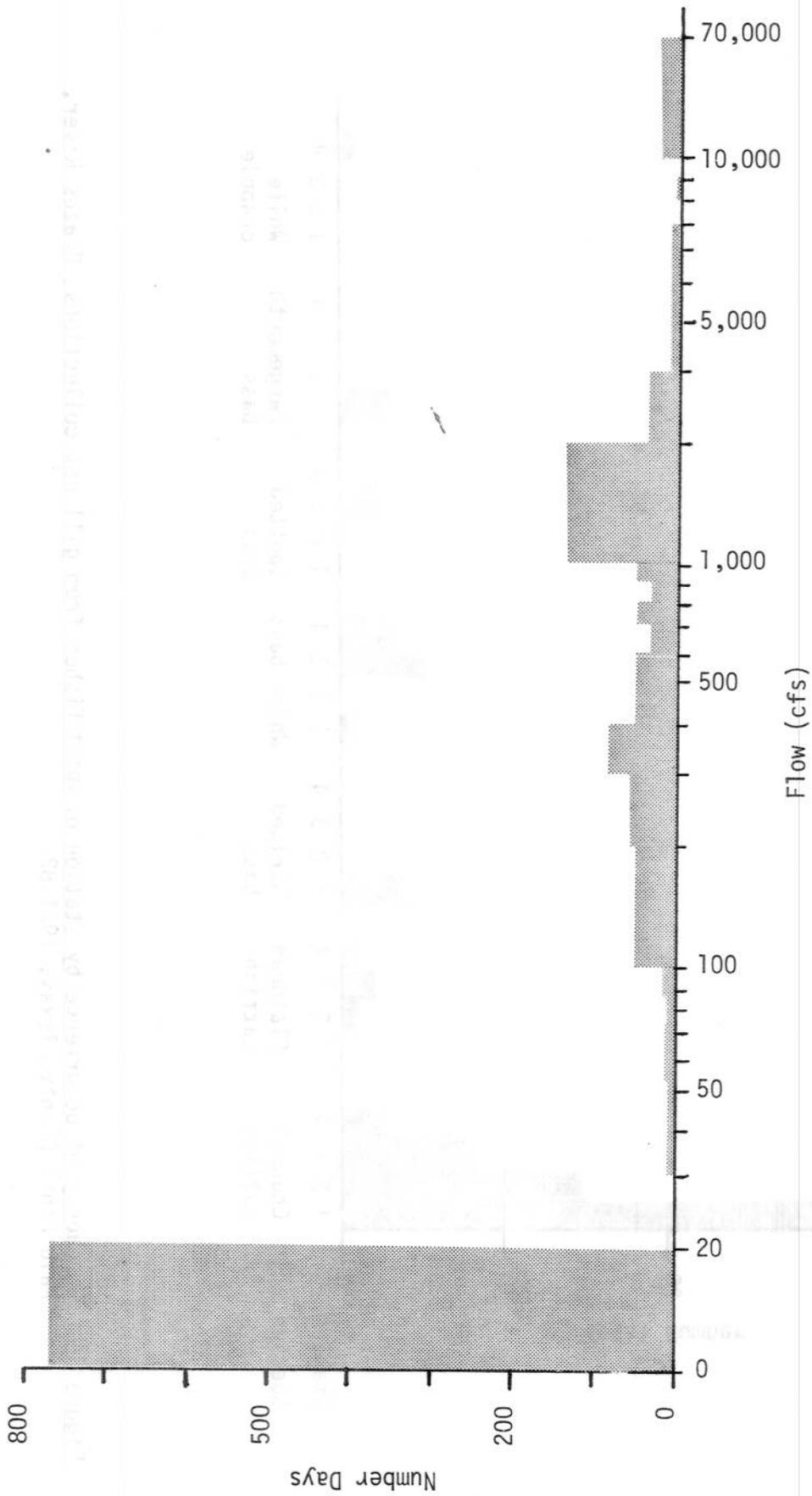


Figure 13. Flow-frequency distribution of discharge (cfs) from Morris Sheppard Dam, Palo Pinto County, Texas, 1978-1981. Water release records obtained from the Brazos River Authority.

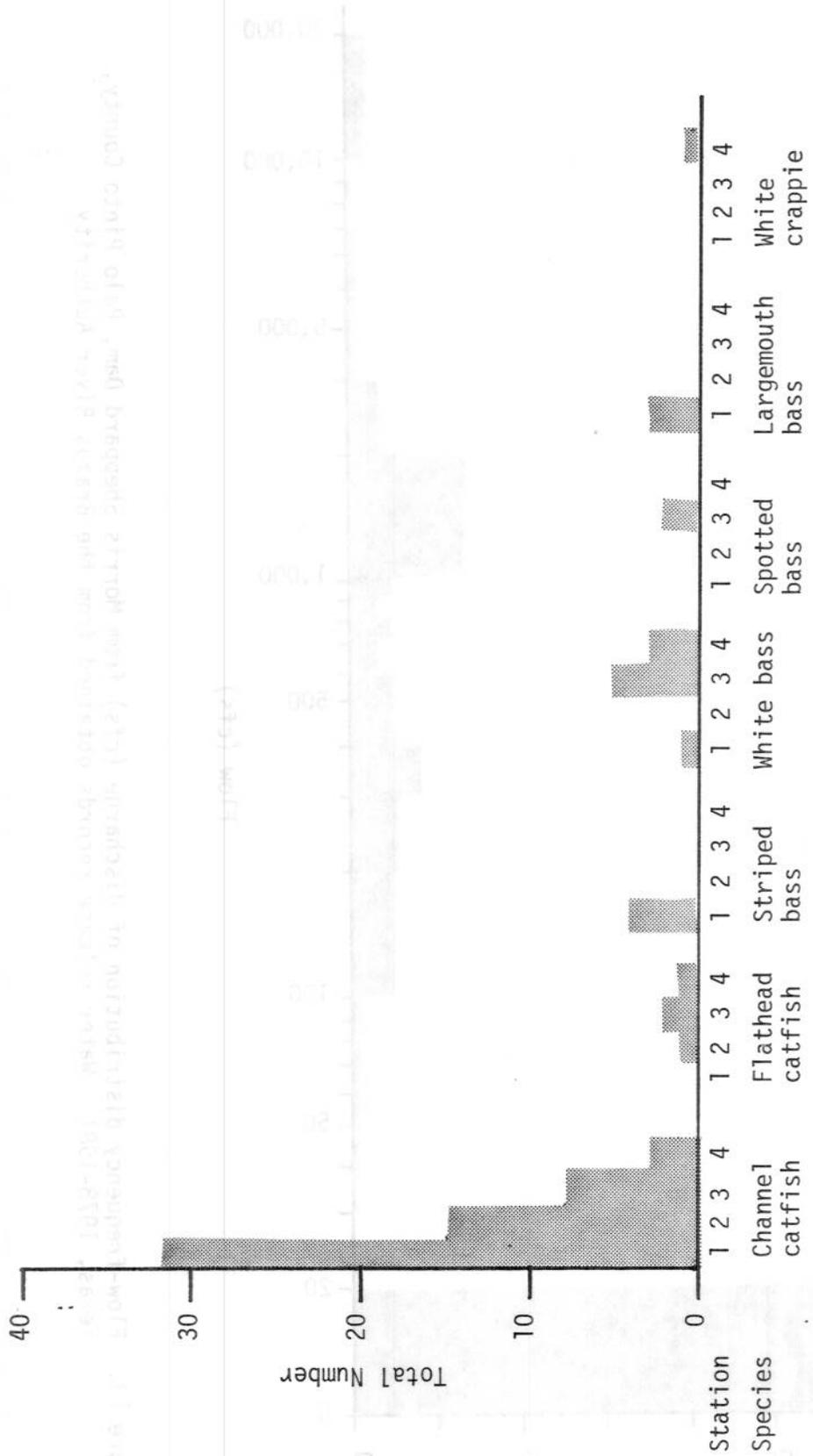


Figure 14. Frequency of occurrence by station of sport fishes from gill net collections, Brazos River, Palo Pinto County, Texas, 1981-82.

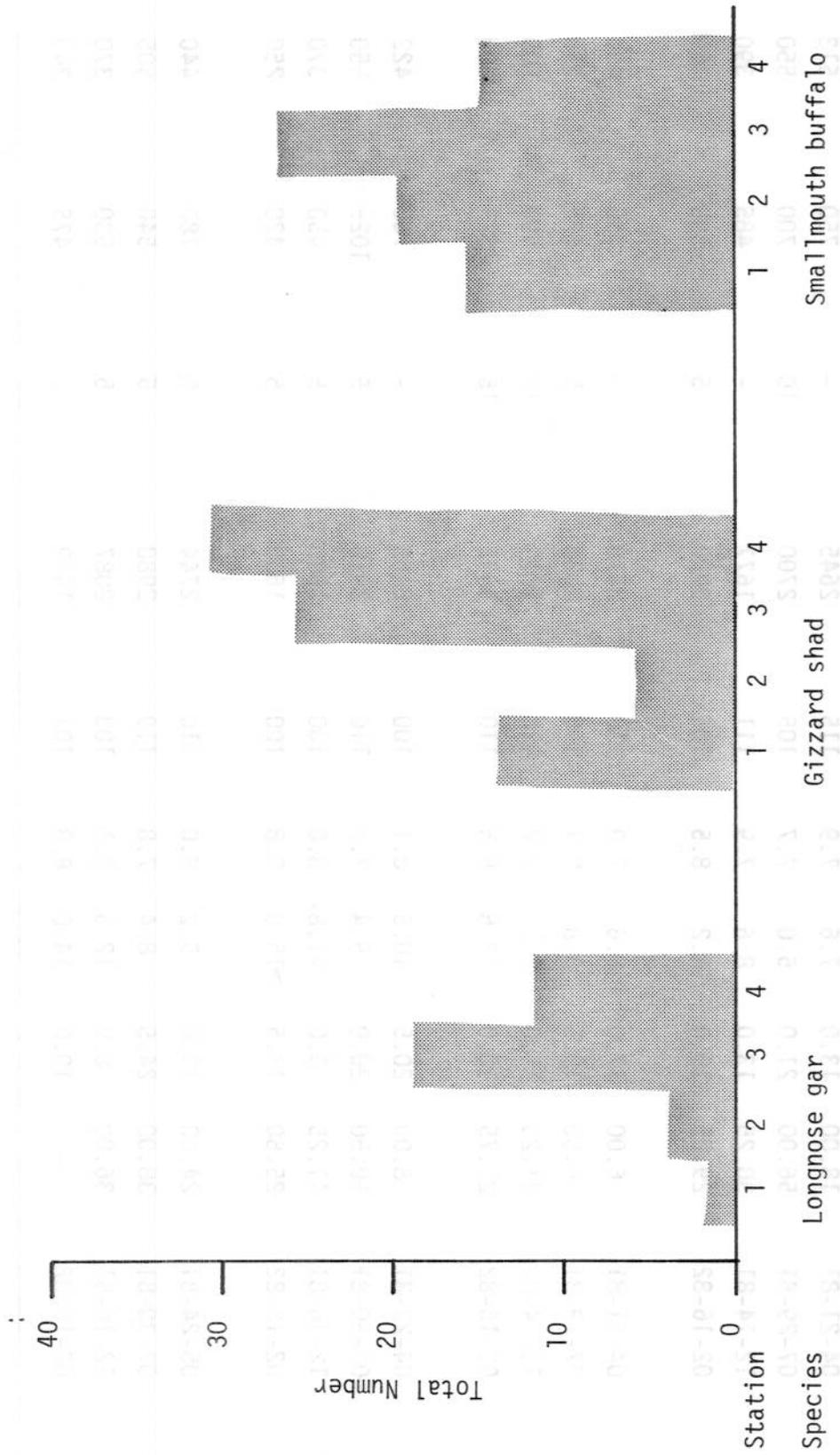


Figure 15. Frequency of occurrence by station of rough fishes from gill net collections, Brazos River, Palo Pinto County, Texas, 1981-82.

Table 1. Surface-water physicochemical data, Brazos River, Palo Pinto County, Texas, 1981-1982.

Station	Date	Secchi Disc (in)	Temp (C)	D. O. (ppm)	pH	Total Alk. (ppm)	Specific Conductance (umhos/cm)	Turbidity (FTU)	Chlorides (ppm)	Total Hardness (ppm)
1	04-21-81	18.00	13.0	7.6	7.9	115	2645	-	750	513
	07-29-81	56.00	21.0	5.0	7.7	105	2700	10	700	550
	12-14-81	30.25	13.0	8.6	7.9	111	1677	-	485	390
	02-16-82	29.25	10.0	14.2	8.5	105	2070	5	500	360
2	04-21-81	6.00	17.0	8.6	7.9	110	2478	-	735	450
	07-29-81	28.50	19.5	3.8	8.1	110	2830	5	622	550
	12-14-81	31.25	11.0	7.3	8.2	120	1890	10	690	500
	02-16-82	27.75	10.0	12.6	8.5	110	1932	15	525	300
3	04-23-81	8.00	20.5	10.5	8.1	100	2453	-	760	422
	07-30-81	50.50	20.0	5.4	7.7	110	2915	5	1025	550
	12-16-81	41.25	9.0	11.8	8.0	100	1988	5	450	370
	02-18-82	25.50	13.5	>15.0	8.8	100	1600	5	420	250
4	05-24-81	24.00	19.0	9.2	8.0	110	2744	5	780	440
	07-30-81	38.00	24.5	8.4	7.8	119	2980	5	540	505
	12-16-81	36.00	8.0	12.5	8.1	103	2087	5	530	370
	02-16-82	-	10.0	14.0	8.8	101	1449	3	475	340

Table 2. Stream channel characteristics and flow regimes, Brazos River, Palo Pinto County, Texas, 1981-82.

Station	Date	Pool			Riffle		
		Width (ft)	Mean Depth (ft)	Flow (cfs)	Width (ft)	Mean Depth (ft)	Flow (cfs)
1	04-21-81	150	3.4	41.3	50	0.9	26.3
	07-29-81 *	160	8.3	860.5	75	1.2	134.5
	12-14-81 *	160	5.0	129.6	75	1.9	271.9
	02-16-82	150	6.4	34.6	50	1.3	8.8
2	04-22-81	80	3.1	20.1	80	0.5	121.9
	07-29-81	80	4.3	105.3	80	0.5	71.0
	12-14-81 *	80	3.3	161.6	150	0.9	222.5
	02-16-82	80	3.9	14.0	80	0.5	53.8
3	04-23-81	100	3.8	75.2	114	0.3	100.7
	07-30-81	100	6.1	373.3	120	0.4	148.2
	12-16-81 *	100	4.3	100.6	122	0.6	110.7
	02-18-82	100	7.1	63.9	50	1.2	8.1
4	05-24-81	375	2.8	293.0	75	1.0	131.6
	07-30-81	375	3.1	261.6	75	1.0	224.8
	12-16-81 *	400	4.0	1,267.2	85	0.8	184.8
	02-18-82	375	2.1	21.3	75	0.6	30.4

* Discharging from Morris Sheppard Dam generating station.

Table 3. Aquatic vegetation checklist, all stations, Brazos River, Palo Pinto County, Texas, April 1981 - February 1982.

Common Name	Scientific Name
Black willow	<u>Salix nigra</u>
Cottonwood	<u>Populus</u> sp.
Buttonbush	<u>Cephalanthus occidentalis</u>
Salt cedar	<u>Tamarix</u> sp.
Spikerush	<u>Eleocharis</u> sp.
Needlerush	<u>Eleocharis acicularis</u>
Water willow	<u>Justicia americana</u>
Water star grass	<u>Heteranthera</u> sp.
Sago pondweed	<u>Potamogeton pectinatus</u>
Pondweed	<u>Potamogeton</u> sp.
Algae	Chlorophyceae

Table 4. Aquatic vegetation by station, Brazos River, Palo Pinto County, Texas, April 1981 - February 1982.

Station Number	Common Name	Scientific Name	Per cent of station area occupied
1	Black willow	<u>Salix nigra</u>	5
	Cottonwood	<u>Populus sp.</u>	5
	Buttonbush	<u>Cephalanthus occidentalis</u>	1
	Salt cedar	<u>Tamarix sp.</u>	1
	Spikerush	<u>Eleocharis sp.</u>	1
	Sago pondweed	<u>Potamogeton pectinatus</u>	20
	Algae	Chlorophyceae	30
	2	Black willow	<u>Salix nigra</u>
Buttonbush		<u>Cephalanthus occidentalis</u>	5
Salt cedar		<u>Tamarix sp.</u>	5
Water star grass		<u>Heteranthera sp.</u>	5
Pondweed		<u>Potamogeton sp.</u>	10
Algae		Chlorophyceae	30
3		Black willow	<u>Salix nigra</u>
	Cottonwood	<u>Populus sp.</u>	1
	Salt cedar	<u>Tamarix sp.</u>	1
	Spikerush	<u>Eleocharis sp.</u>	1
	Needlerush	<u>Eleocharis acicularis</u>	1
	Water willow	<u>Justicia americana</u>	1
	Pondweed	<u>Potamogeton sp.</u>	10
	Algae	Chlorophyceae	30
4	Black willow	<u>Salix nigra</u>	10
	Cottonwood	<u>Populus sp.</u>	10
	Salt cedar	<u>Tamarix sp.</u>	5
	Pondweed	<u>Potamogeton sp.</u>	5
	Algae	Chlorophyceae	30

Table 5. Seine sample statistics, 8 sample sites (pool and riffle), Brazos River, Palo Pinto County, Texas, 1981-82.

Species	Total number of each inch group per 1,000 ft ²						Total
	1	2	3	4	5	>5	
<u>Spring</u>							
Gizzard shad	-	-	-	-	-	0.20	0.20
Threadfin shad	-	-	-	0.45	0.05	-	0.50
Silver chub	-	-	-	0.05	-	-	0.05
Red shiner	0.30	5.40	0.05	-	-	-	5.75
Blacktail shiner	-	0.15	0.45	0.20	-	-	0.80
Bullhead minnow	-	0.70	-	-	-	-	0.70
Mosquitofish	5.40	0.50	-	-	-	-	5.90
Inland silverside	-	-	-	0.05	-	-	0.05
Spotted bass	-	-	-	0.05	-	-	0.05
Longear sunfish	0.05	0.05	0.15	0.05	0.05	-	0.35
Dusky darter	-	-	0.05	-	-	-	0.05
Total	5.75	6.80	0.70	0.85	0.10	0.20	14.40
<u>Summer</u>							
Red shiner	-	2.15	0.20	-	-	-	2.35
Blacktail shiner	-	0.20	-	0.65	-	-	0.85
Bullhead minnow	-	0.05	-	-	-	-	0.05
Mosquitofish	0.10	0.10	-	-	-	-	0.20
Inland silverside	0.40	1.05	0.25	-	-	-	1.70
Bluegill	-	-	0.05	-	-	-	0.05
Longear sunfish	-	0.10	0.10	0.05	-	-	0.25
Spotted bass	-	-	0.15	0.05	0.05	0.05	0.30
Largemouth bass	-	-	0.05	0.10	-	-	0.15
Total	0.50	3.65	0.80	0.85	0.05	0.05	5.90
<u>Fall</u>							
Threadfin shad	-	0.10	-	-	-	-	0.10
Speckled chub	-	0.05	-	-	-	-	0.05
Red shiner	0.35	1.55	0.05	-	-	-	1.95
Blacktail shiner	0.05	7.30	3.60	0.15	-	-	11.10
Mimic shiner	-	0.05	-	-	-	-	0.05
Bullhead minnow	0.10	3.15	0.05	-	-	-	3.30
Mosquitofish	0.10	-	-	-	-	-	0.10
Inland silverside	-	4.50	5.30	0.20	-	-	10.00
Longear sunfish	-	-	-	-	0.05	-	0.05
Total	0.60	16.70	9.00	0.35	0.05	-	26.70

Table 5. (Continued)

Species	Total number of each inch group per 1,000 ft ²					Total
	1	2	3	4	5	
	<u>Winter</u>					
Red shiner	5.00	5.60	0.15	-	-	10.75
Blacktail shiner	0.20	9.40	2.85	-	-	12.45
Bullhead minnow	0.15	1.65	-	-	-	1.80
Channel catfish	-	-	-	-	0.05	0.05
Inland silverside	-	5.55	6.50	-	-	12.05
Bluegill	0.05	-	-	-	-	0.05
Orangethroat darter	-	0.10	-	-	-	0.10
Logperch	-	-	-	-	0.05	0.05
Dusky darter	-	-	0.05	-	-	0.05
Freshwater drum	-	-	-	-	-	0.05
Total	5.40	22.30	9.55	-	0.10	37.40

Table 6. Gill net sampling statistics, four net nights, Brazos River, Palo Pinto County, Texas, April, 1981.

Species	Total Number	Number per 200 ft. of net	Total Weight (lb)	Weight per 200 ft. of net (lb)	Mean Weight (lb)
Spotted gar	1	0.25	1.0	0.25	1.00
Longnose gar	21	5.25	35.2	8.80	1.68
Gizzard shad	29	7.25	15.2	3.80	0.52
Threadfin shad	7	1.75	0.1	0.03	0.01
Carp	4	1.00	6.4	1.60	1.60
Blacktail shiner	3	0.75	0.1	0.03	0.03
River carpsucker	2	0.50	1.2	0.30	0.60
Smallmouth buffalo	24	6.00	109.4	27.35	4.56
Channel catfish *	9	2.25	25.4	6.35	2.82
Flathead catfish *	3	0.75	27.7	6.93	9.23
Striped bass *	2	0.50	11.5	2.88	5.75
Bluegill *	2	0.50	0.4	0.10	0.20
Longear sunfish *	1	0.25	0.1	0.03	0.10
GS x LE sunfish hybrid *	1	0.25	0.1	0.03	0.10
Largemouth bass *	1	0.25	0.6	0.15	0.60
White crappie *	1	0.25	0.2	0.05	0.20
Total	111	27.75	234.6	58.65	
Sport Fishes	20	5.00	66.0	16.50	
Rough Fishes	91	22.75	168.6	42.15	

* Sport Fish

Table 7. Gill net sampling statistics, four net nights, Brazos River, Palo Pinto County, Texas, July, 1981.

Species	Total Number	Number per 200 ft. of net	Total Weight (lb)	Weight per 200 ft. of net (lb)	Mean Weight (lb)
Longnose gar	3	0.75	18.9	4.73	6.30
Gizzard shad	13	3.25	5.8	1.45	0.45
Carp	3	0.75	5.4	1.35	1.80
River carpsucker	4	1.00	2.1	0.53	0.53
Smallmouth buffalo	19	4.75	48.6	12.15	2.56
Channel catfish *	13	3.25	21.1	5.28	1.62
Flathead catfish *	1	0.25	7.0	1.75	7.00
White bass *	1	0.25	1.2	0.30	1.20
Striped bass *	1	0.25	1.8	0.45	1.80
Warmouth *	1	0.25	0.1	0.03	0.10
Longear sunfish *	1	0.25	0.1	0.03	0.10
Spotted bass *	1	0.25	0.2	0.05	0.20
Largemouth bass *	2	0.50	1.1	0.28	0.55
Freshwater drum	2	0.50	19.5	4.88	9.75
Total	65	16.25	132.9	33.23	
Sport Fishes	21	5.25	32.6	8.15	
Rough Fishes	44	11.00	100.3	25.08	

* Sport Fish

Table 8. Gill net sampling statistics, four net nights, Brazos River, Palo Pinto County, Texas, December, 1981.

Species	Total Number	Number per 200 ft. of net	Total Weight (lb)	Weight per 200 ft. of net (lb)	Mean Weight (lb)
Longnose gar	9	2.25	50.1	12.53	5.57
Gizzard shad	14	3.50	4.0	1.00	0.29
Carp	2	0.50	3.7	0.93	1.85
River carpsucker	3	0.75	1.4	0.35	0.47
Smallmouth buffalo	15	3.75	42.3	10.58	2.82
Channel catfish *	7	1.75	8.0	2.00	1.14
White bass *	7	1.75	5.0	1.25	0.72
Striped bass *	1	0.25	3.5	0.88	3.50
Striped bass hybrid *	1	0.25	5.9	1.48	5.90
Bluegill *	1	0.25	0.1	0.03	0.10
Longear sunfish *	1	0.25	0.1	0.03	0.10
Freshwater drum	1	0.25	0.1	0.03	0.10
Total	62	15.50	124.2	31.05	
Sport Fishes	18	4.50	22.6	5.65	
Rough Fishes	44	11.00	101.6	25.40	

* Sport Fish

Table 9. Gill net sampling statistics, four net nights, Brazos River, Palo Pinto County, Texas, February, 1982.

Species	Total Number	Number per 200 ft. of net	Total Weight (lb)	Weight per 200 ft. of net (lb)	Mean Weight (lb)
Longnose gar	4	1.00	19.5	4.88	4.88
Gizzard shad	21	5.25	8.5	2.13	0.40
River carpsucker	8	2.00	4.5	1.13	0.56
Smallmouth buffalo	20	5.00	102.3	25.58	5.12
Golden redhorse	2	0.50	1.2	0.30	0.60
Channel catfish *	29	7.25	31.8	7.95	1.10
White bass *	1	0.25	0.5	0.13	0.50
Bluegill *	1	0.25	0.2	0.05	0.20
Spotted bass *	1	0.25	2.0	0.50	2.00
Largemouth bass *	1	0.25	0.6	0.15	0.60
Logperch	1	0.25	Tr.+	-	0.03
Freshwater drum	1	0.25	0.5	0.13	0.50
Total	90	22.50	171.6	42.90	
Sport Fishes	33	8.25	35.1	8.78	
Rough Fishes	57	14.25	136.5	34.12	

* Sport Fish

+ Trace is used for amounts less than 0.05.

Table 10. Average back-calculated total lengths (mm) of channel catfish collected from the Brazos River, Palo Pinto County, Texas, 1981-82.

Age Group	Year Class	Number Sampled	Total Length (mm) at Year								
			1	2	3	4	5	6	7		
0	1981										
3	1978	2	123.6	222.5	311.5						
4	1977	7	139.8	240.8	297.7	349.0					
5	1976	2	127.7	240.6	308.1	397.9	464.9				
6	1975	3	154.7	208.5	286.8	343.3	389.7	438.7			
7	1974	2	125.9	215.6	280.3	385.1	446.5	487.1	538.9		
Grand avg-weighted 16			137.39	229.34	296.54	359.98	427.48	458.09	538.98		
Average increments			137.39	91.95	67.20	63.44	67.50	30.61	80.89		
Average annual incr.			137.39	91.94	67.20	65.58	56.59	45.61	51.83		
Sum of annual incr.			137.39	229.33	296.53	362.11	418.70	464.31	516.14		

Table 11. Growth of channel catfish in the Brazos River, Palo Pinto County, Texas and other waters.

Water	Total Length (mm) at Year						
	1	2	3	4	5	6	7
Brazos River, TX	137	229	297	360	427	458	539
Lake Palo Pinto, TX ¹	107	205	316	335	405	457	-
Lake Kickapoo, TX ²	199	244	-	-	-	-	-
Grand Lake, OK ³	76	145	211	269	333	401	457
Lake Texoma ³	137	221	272	318	353	373	-
Little River, OK ⁴	94	198	277	330	452	-	-
Lake Lawtonka, OK ⁴	104	196	284	351	417	467	521
Six Streams in OK ⁴	107	196	279	348	409	472	495
Verdigris River, OK ⁴	84	140	198	246	302	351	406

1 (Hysmith et al. 1982)

2 (Parks 1981)

3 (Miller 1966)

4 (Carlander 1969)

Table 12. Recommended monthly minimum instantaneous flow (cfs) on the Brazos River at the Morris Sheppard Dam, above Possum Kingdom Reservoir (PKR) near South Bend, Texas and below PKR near Palo Pinto, Texas

Month	Brazos River near South Bend*	Morris Sheppard Dam **	Brazos River near Palo Pinto*
January	24	39	54
February	23	33	42
March	31	48	65
April	41	58	74
May	179	197	215
June	260	332	403
July	66	194	322
August	42	135	227
September	68	119	170
October	49	71	92
November	35	45	54
December	27	37	46

* Based on recommended minimum flow (Lyons 1979).

** Average between first and third columns.

5-Year Management Plan for
Brazos River between Texas
Highway 16 and Farm Road 4
1983-1987

River Description:

The Brazos River is the third largest river in Texas. It originates in west-central Texas as the Double Mountain, Salt, and Clear Forks of the Brazos and flows southeasterly for approximately 840 mi to the Gulf of Mexico. The river flows through most of the main land resource areas of the Texas-High Plains, Rolling Plains, North Central Prairies, Cross Timbers, Grand Prairie, Blackland Prairies, Central Basin, and Claypan Area, and drains about 42,800 mi².

This study was conducted on approximately 20 mi of the Brazos River in Palo Pinto County between Morris Sheppard Dam, which impounds Possum Kingdom Lake, and Farm-to-Market Road 4 (Fig. 1A). The dam is controlled by the Brazos River Authority which produces power for the Brazos Electric Cooperative System. The area is confined to the North Central Prairies land resource area and included the major tributaries Garland, Ioni, Eagle, and Dark Valley Creeks. This section of the river is generally clear, has 13 major pools, numerous riffles, and many backwater flats. These physical features vary greatly with releases from the reservoir. At low flow (≤ 20 cfs) many of the riffles and backwater flats dry up. During periods of high flow ($\geq 1,000$ cfs) the river rises 2-3 ft. The stream gradient is 2.7 ft/mi and depth ranges from 0.1 to 15 ft. Recreation is an important resource on this portion of the river.

Topography in this section ranged from moderately wooded and grassy hills to thickly wooded or cultivated bottomland. Cedar, mesquite, and native grasses predominated surrounding hills. Cottonwood, cedar, persimmon, salt cedar, willow, and native grasses were abundant along the shoreline, while the bottomland vegetation consisted primarily of pecan, cottonwood, oak, low shrubs, and native grasses. Mean annual rainfall in this immediate area is 28 in; in the headwaters of the Brazos River it is 16 to 20 in.

Major sport fishes included rainbow trout, channel catfish, white bass, striped bass, sunfishes, spotted bass, largemouth bass, and white crappie.

Physicochemical Characteristics

Basically, water quality in this section of the Brazos River was compatible with fish life. Two exceptions to this generalization were frequent and drastic fluctuations in water temperature, and variation in flow regimes resulting from hydroelectric power generation from Morris Sheppard Dam. To alleviate this, the monthly minimum instantaneous flow (discharge) from Morris Sheppard Dam should be increased (Table 1A). Monthly minimum instantaneous flow in this section of the Brazos River (U.S.G.S. Station No. 08089000, at FM4, Palo Pinto County, Texas) should vary from 42-403 cfs with maximum flow occurring May-September. Our recommended flow at the Morris Sheppard Dam (Table 1A) is based on an average of upstream monthly minimum instantaneous flow and a downstream monthly minimum instantaneous flow. This average flow was selected to compensate for non-recorded inflow

from tributaries between the U.S.G.S. gaging station at South Bend, Texas and Morris Sheppard Dam, and for the influence of runoff from tributaries between the dam and the U.S.G.S. gaging station at FM 4.

Fish Habitat

The river immediately downstream from the Texas Highway 16 bridge is a cool, clear water stream with a bottom of sand, gravel, rubble, and boulders. As it progresses towards the FM 4 bridge, it becomes more turbid, and the bottom contains more muck, detritus, and clay. About 1.5 to 2 mi upstream of FM 4 the river bottom is scoured bedrock. The most limiting factor for the fishery is the volume of flow which is insufficient to maintain stream habitat for adequate sport fish production. An increase in monthly minimum instantaneous flow (Table 1A) in this section of the river would allow for increased sport fish production by reclaiming all or a portion of the estimated 49 percent of the stream course dewatered during low flow (≤ 20 cfs). At the recommended monthly minimum instantaneous flows, an estimated 85 to 100 percent of the stream course would be watered most of the time, as opposed to 51 percent under current flow regimes (1978-1981).

Fish Community

With the exception of channel catfish, the sport fishery for this section of the Brazos River is very poor. Seasonal and flow-induced immigration of white bass and striped bass, and the introduction of catchable rainbow trout in the tailrace below Morris Sheppard Dam during November - March, provides a temporary supplement to the fishery. However, we believe a more permanent solution would be in the best interest of angling recreation in this section of the river. The sport fishery in this section of the river would be enhanced through the implementation of recommended flow regimes. Additionally, the introduction of smallmouth bass would further enhance the fishery through increased species diversity. Smallmouth bass prefer a stream with a gravel or rocky bottom, clear, cool water, riffles, boulders, and pools over 4-ft deep. In spite of extreme fluctuations in water temperature, this section of the river meets most of these requirements. Smallmouth bass might prove more suitable than native black basses to the existing environment. Because of increased utilization and public interest, the annual rainbow trout "put-and-take" stocking program should be continued.

Public Access and Facilities

Public access to this section of the Brazos River is limited to a 1 mi portion of the river between Morris Sheppard Dam and the Texas Highway 16 bridge and the FM 4 bridge crossing. There are numerous private access points and access can be gained in many cases with permission of the land owner. The only facility is a small camp area with toilets provided by the Brazos River Authority immediately below the Morris Sheppard Dam. Canoe and float trip enthusiasts utilize the river frequently between March and October. Heavy use of the area near the Texas Highway 16 bridge coincides with our "put-and-take" rainbow trout program. Although trash receptacles are provided in this area, chemical toilets should be installed. Throughout the year other anglers utilize the tailrace and the large pool adjacent the Possum Kingdom State Fish Hatchery, especially for white bass and striped bass.

Fisherman Information

The fishing opportunities of this section of the Brazos River are well known through local and Dallas-Fort Worth Metroplex newspapers. Additional fisherman information should be publicized.

Fish Harvest Regulations

Existing fishing regulations are adequate at this time, and no regulation changes are needed.

Management Recommendations

Year	Activity	Man-days
1983	Present plan to Brazos River Authority (BRA).	4
	<u>Physicochemical characteristics</u>	
	1. Initiate action with BRA to regulate water releases from Morris Sheppard Dam according to Table 1A.	1
	<u>Fish habitat</u>	
	1. Same as Item 1 Physicochemical characteristics.	
	<u>Fish community</u>	
	1. Stock 250,000 smallmouth bass fingerlings.	4
	2. Check for survival of fingerlings.	12
	3. Continue rainbow trout stocking program.	
	<u>Public access and facilities</u>	
	1. Encourage the installation of chemical toilets at Texas Highway 16 bridge by the Texas Department of Highways and Public Transportation or Palo Pinto County.	2
	<u>Fisherman information</u>	
	1. Publicize fisherman information.	1
	<u>Fish harvest regulations</u>	
	No action needed.	
1983	TOTAL	24

Year	Activity	Man-days
1984	<u>Physicochemical characteristics</u>	
	No action needed.	
	<u>Fish habitat</u>	
	No action needed.	

Year	Activity	Man-days
1984	<u>Fish community</u>	
	1. Stock 250,000 smallmouth bass fingerlings.	4
	2. Check for survival of smallmouth bass.	20
	3. Continue rainbow trout stocking program.	
	<u>Public access and facilities</u>	
	1. Follow up on chemical toilets.	1
	<u>Fisherman information</u>	
	1. Publicize fisherman information.	1
	<u>Fish harvest regulations</u>	
	No action needed.	
1984	TOTAL	26

Year	Activity	Man-days
1985	<u>Physicochemical characteristics</u>	
	No action needed.	
	<u>Fish habitat</u>	
	No action needed.	
	<u>Fish community</u>	
	1. Stock 250,000 smallmouth bass fingerlings.	4
	2. Check for reproduction and survival of smallmouth bass.	10
	3. Evaluate the impact to the fish community of streamflow regimes recommended and implemented in 1983.	20
	4. Continue rainbow trout stocking program.	
	<u>Public access and facilities</u>	
	No action needed.	
	<u>Fisherman information</u>	
	1. Publicize fisherman information.	1
	<u>Fish harvest regulations</u>	
	No action needed.	
1985	TOTAL	35

Year	Activity	Man-days
1986	<u>Physicochemical characteristics</u>	
	No action needed.	
	<u>Fish habitat</u>	
	No action needed.	
	<u>Fish community</u>	
	1. Check for reproduction and survival of smallmouth bass.	20
	2. Continue rainbow trout stocking program.	
	<u>Public access and facilities</u>	
	No action needed.	
	<u>Fisherman information</u>	
	1. Publicize fisherman information.	1
	<u>Fish harvest regulations</u>	
	No action needed.	

1986	TOTAL	21
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Year	Activity	Man-days
1987	<u>Physicochemical characteristics</u>	
	No action needed.	
	<u>Fish habitat</u>	
	No action needed.	
	<u>Fish community</u>	
	1. Check for reproduction and survival of smallmouth bass.	20
	2. Continue rainbow trout stocking program.	
	<u>Public Access and facilities</u>	
	No action needed.	
	<u>Fisherman information</u>	
	1. Publicize fisherman information.	1
	<u>Fish harvest regulations</u>	
	No action needed.	

Year	Activity	Man-days
1987	TOTAL	21

Total estimated man-days for the management of a 20-mi section of the Brazos River = 127 Man-days.

Year	Activity	Man-days
1987	1. Publicize fisherman information	1
	2. Fish harvest regulations	
	No action needed	
1987	TOTAL	21
1987	1. Publicize fisherman information	1
	2. Fisherman information	
	No action needed	
1987	1. Check for reproduction and survival of smallmouth bass	20
	2. Continue rainbow trout stocking program	
	3. Public Access and facilities	
	No action needed	
1987	TOTAL	21

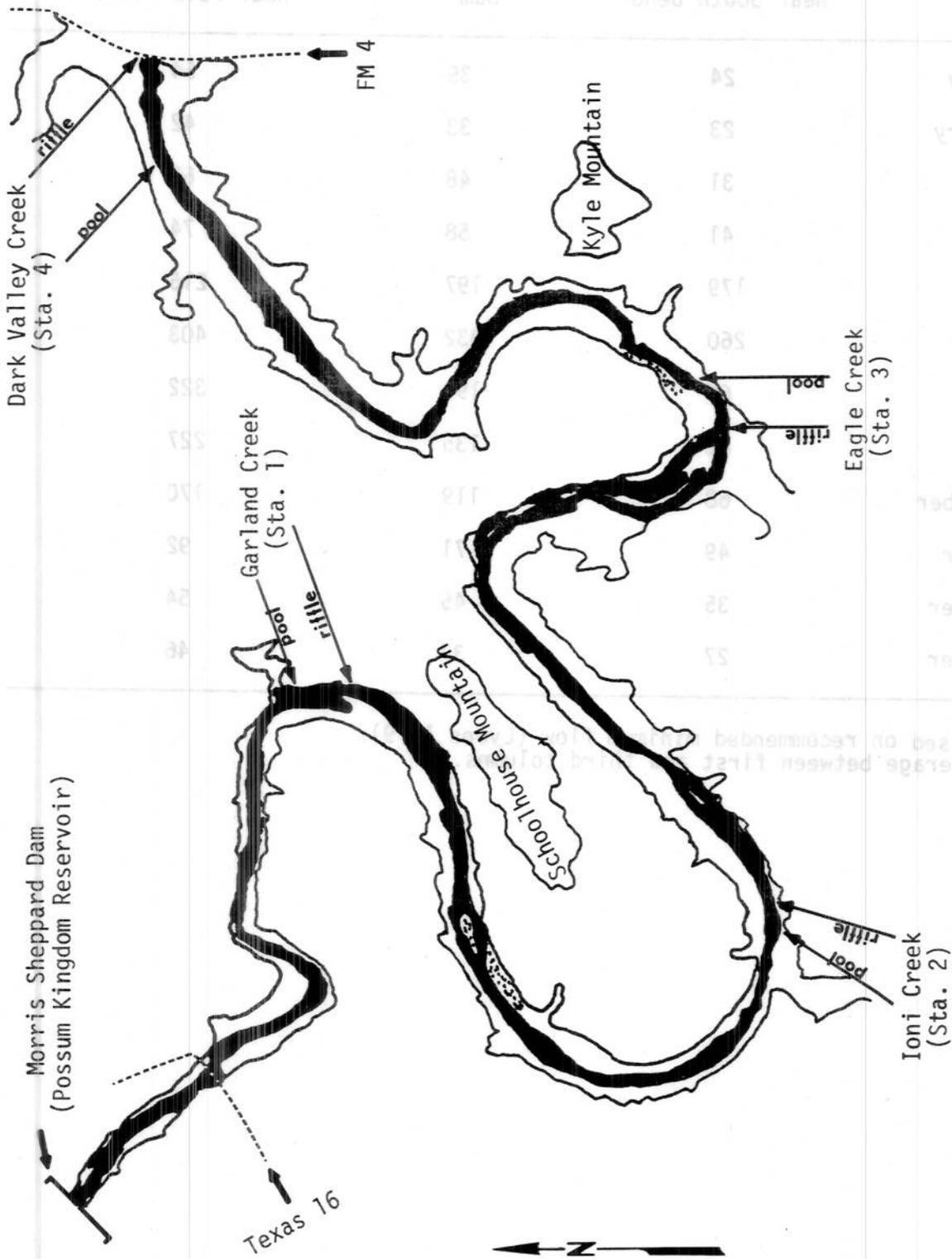


Figure 1A. Location of sample stations in a 20-mile segment below Possum Kingdom Reservoir, Brazos River, Palo Pinto County, Texas, 1981-82.

Table 1A. Recommended monthly minimum instantaneous flow (cfs) on the Brazos River at the Morris Sheppard Dam, above Possum Kingdom Reservoir (PKR) near South Bend, Texas and below PKR near Palo Pinto, Texas.

Month	Brazos River near South Bend*	Morris Sheppard Dam **	Brazos River near Palo Pinto*
January	24	39	54
February	23	33	42
March	31	48	65
April	41	58	74
May	179	197	215
June	260	332	403
July	66	194	322
August	42	135	227
September	68	119	170
October	49	71	92
November	35	45	54
December	27	37	46

* Based on recommended minimum flow (Lyons 1979).
 ** Average between first and third columns.

