FINAL REPORT

As Required by

THE ENDANGERED SPECIES ACT, SECTION 6

TEXAS
Project No: E-1-4

ENDANGERED AND THREATENED SPECIES CONSERVATION

Job No. 7.0

Smalleye Shiner Status Survey and Habitat Profile

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STATE: Texas **PROJECT NO.:** E-1-4

PROJECT TITLE: Endangered and Threatened Species Conservation.

PERIOD COVERED: September 1, 1991 - August 31, 1992

JOB NUMBER: 7.0

JOB TITLE: Smalleye Shiner Status Survey and Habitat Profile

JOB OBJECTIVE: Determine the historical occurrence and current distribution of the smalleye shiner (Cyprinidae: Notropis buccula Cross) throughout its known range. If viable populations of smalleye shiners can be located, then quantitative habitat measurements will be made to clarify life history requirements for this Texas endemic species.

ACCOMPLISHMENTS

See attached report .

SIGNIFICANT DEVIATIONS

None.

PREPARED BY: Randy Moss 3-12-93
Date

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Title

APPROVED BY: 3-12-93
Date

Larry D. McKinney, Ph.D.
Director, Resource Protection Division

Current Status

of

Notropis buccula

and

Notropis oxyrhynchus

in Texas

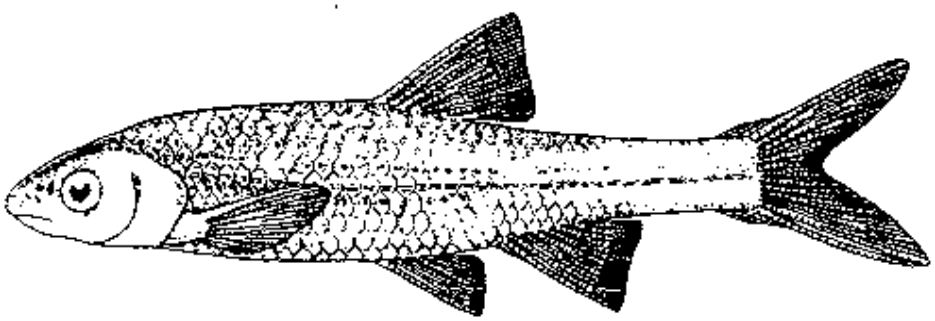
by

Randall E. Moss

and

Kevin B. Mayes

Resource Protection Division
Texas Parks and Wildlife Department



Notropis buccula

(Modified from Lee et al. 1980; Renaldo Kuhler illustrator)

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ABSTRACT

Forty one collections were made from the Brazos and the Wichita river systems in Texas to determine the current status of the smalleye shiner, Notropis buccula, and the sharpnose shiner, Notropis oxyrhynchus. A total of 2,388 smalleye shiners were collected. The smalleye shiner was collected from all sites on the Salt Fork Brazos River, Double Mountain Fork Brazos River, and North Fork of the Double Mountain Fork Brazos River, and Croton Creek. Only one collection on the Salt Fork (at U.S. 83 in Stonewall Co.) did not contain smalleye shiners. Although the historic range of the smalleye shiner extends downstream of Possum Kingdom Reservoir, none were collected from the middle and lower Brazos R. system. The sharpnose shiner was collected from the Salt Fork (seven sites), Double Mountain Fork (three sites), and the North Fork of the Double Mountain Fork (three sites). A total of 2,083 sharpnose shiners were collected, however, only 27 were collected from the Brazos River downstream of Possum Kingdom Reservoir. No sharpnose shiners were collected from the Wichita River system.

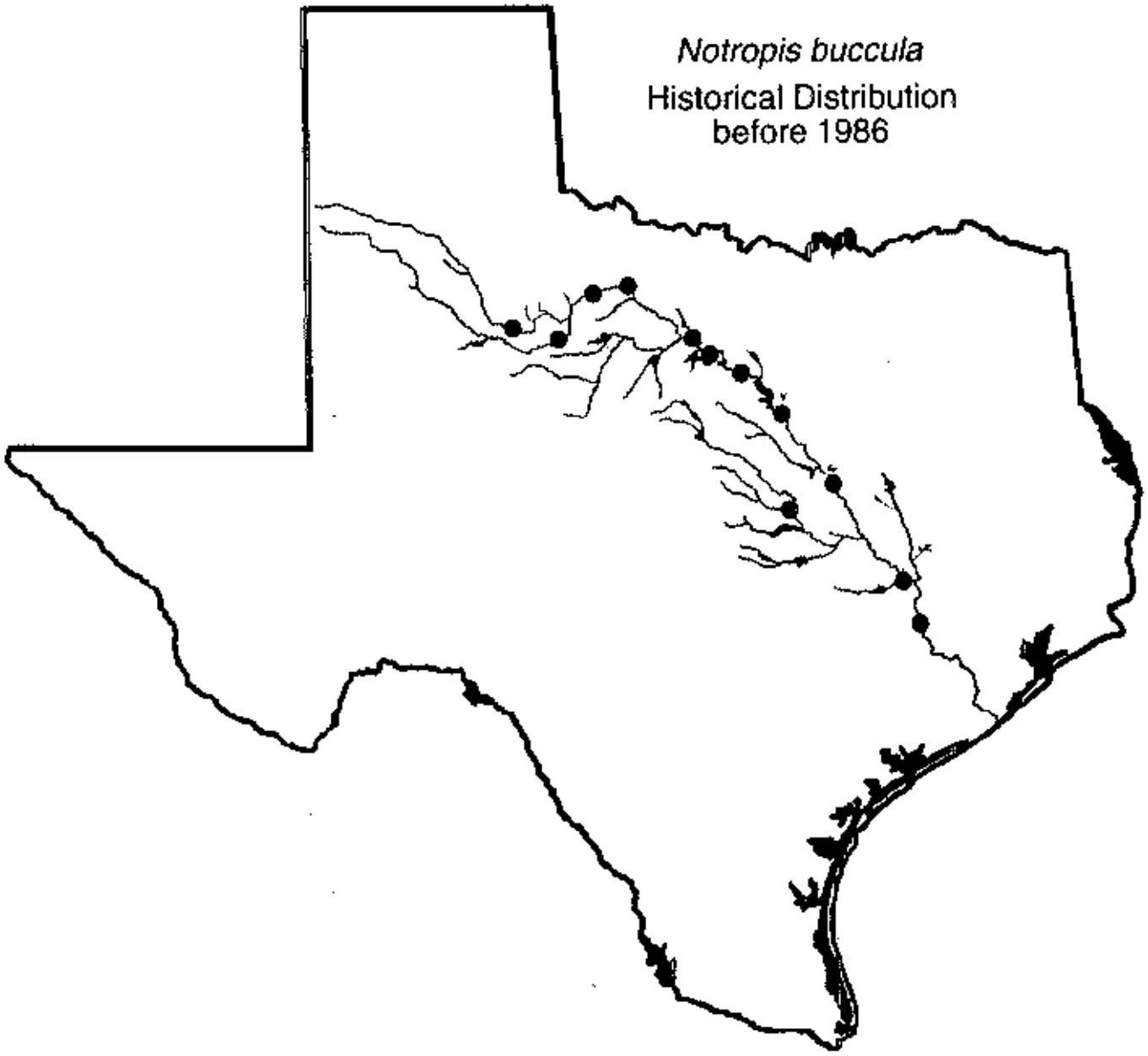
The historical occurrence and distribution of smalleye and sharpnose shiners were determined by the examination of museum specimens and collection records from many of the major and minor fish collections in Texas, Oklahoma, Louisiana, Kansas, and Illinois. The range of both species extended throughout the Brazos

River system and occurrence and abundances, especially in the lower Brazos River have changed dramatically through recent decades. Altered habitat conditions in the Brazos River continue to threaten these two species and proposed water development projects may adversely impact the limited remaining habitat for N. buccula and N. oxyrhynchus. Based on the historical distribution, recent collection information, and the habitat changes that the upper Brazos River system is likely to encounter in the future, it is appropriate that both Notropis buccula and Notropis oxyrhynchus be considered threatened species and that efforts be made to list these species.

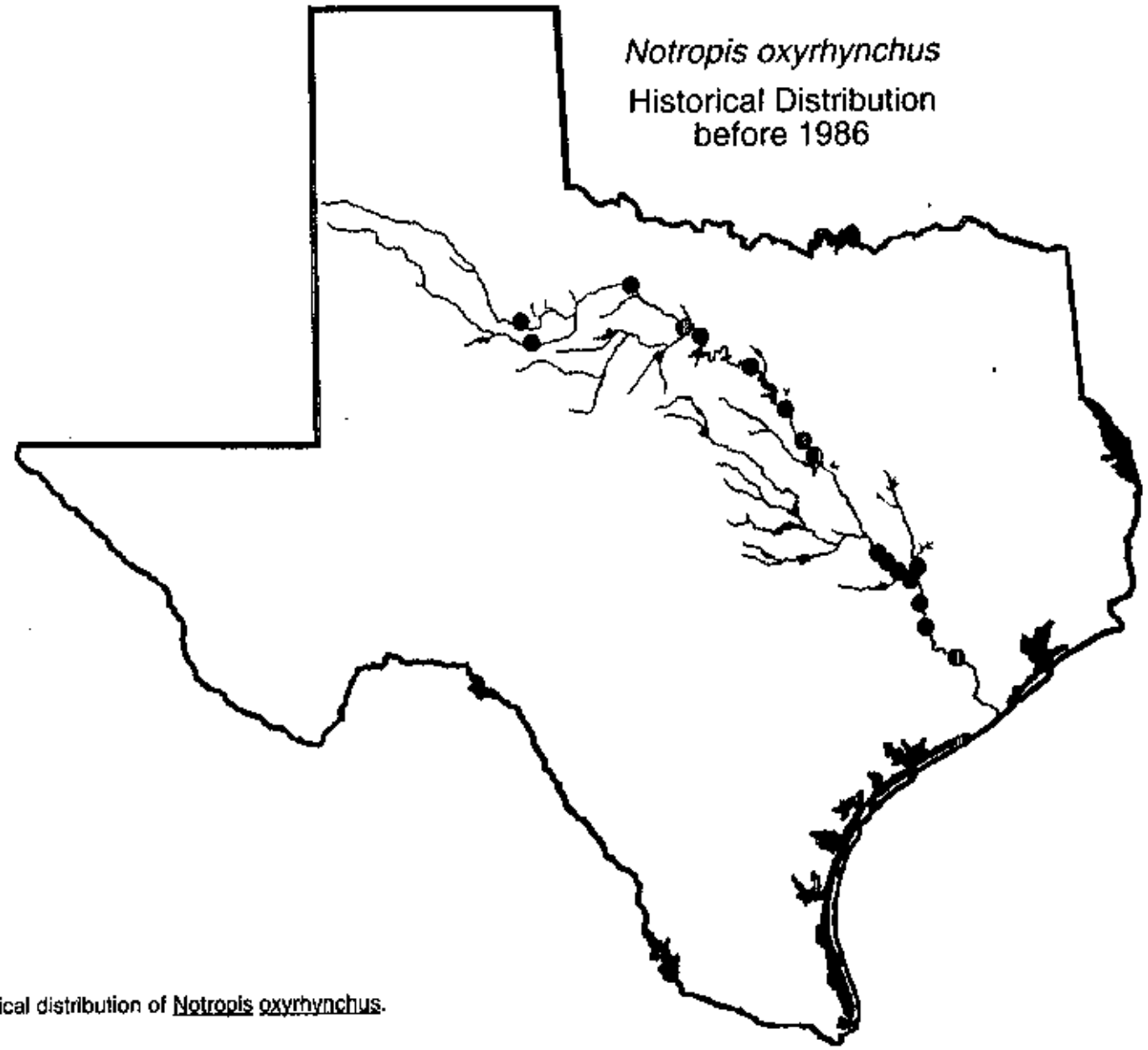
INTRODUCTION

The smalleye shiner (Cyprinidae: Notropis buccula Cross) is listed by the U.S. Department of Interior as a Category Two species and is endemic to the Brazos River system in Texas (**Appendix 3: Photograph 1**). It was originally described as Notropis bairdi buccula (Cross 1953) and subsequently elevated to species status (Hubbs 1957). The fish is a small, pallid shiner historically found throughout the upper and middle Brazos River drainages (**Map 1**) but now appears to be limited to the Brazos R. system upstream of Possum Kingdom Reservoir. This shiner was typically found in broad channels characterized by shallow, often turbid water flowing over shifting sand. The last known collection of N. buccula in museum collections is TAMU 3908.4 from the Brazos River on Route 277 near Seymour, 28 July 1984, by Mike Retzer et al.

Another typical member of that riverine fauna is the sharpnose shiner (Notropis oxyrhynchus Hubbs and Bonham, **Photograph 2**). The sharpnose shiner is also listed by the U.S. Department of the Interior as a Category Two species in need of further information. Notropis oxyrhynchus has been found in the Wichita and the Brazos River systems in Texas (**Map 2**). Recent collections in the Wichita River system have failed to include sharpnose shiners. The distribution of N. oxyrhynchus in the Brazos River includes both the upper and middle sections, but the trend for recent collections has been that the sharpnose shiner is present, but no longer common



Map 1. Historical distribution of Notropis buccula.



Map 2. Historical distribution of Notropis oxyrhynchus.

downstream of the Brazos River mainstem impoundments.

The Brazos River system has been greatly modified by the construction of reservoirs and smaller impoundments for flood control, water supply, hydroelectic generation, agricultural purposes, salinity modification, recreation, and other human uses and benefits (see **Map 5**). The Texas Water Plan (TWDB 1990) describes anticipated future water development projects that may be required if additional human demands occur. Although the number of proposed projects has been reduced from previous planning, there are still five more major reservoirs under consideration.

The Brazos River can be classified as a typical prairie ecosystem characterized by extreme fluctuations in environmental conditions and flow regimes such as floods and droughts (Matthews 1988). The High Plains and prairie fish fauna has been generally described by Cross and Moss (1987) and in regional handbooks (Cross 1967; Miller and Robison 1973; Sublette, Hatch, and Sublette 1990). The effect of habitat alterations, including modified flow regimes, has been documented (Anderson 1980; Anderson, Beitinger, and Zimmerman 1983; Cross, Moss, and Collins 1985; Cross and Moss 1987; Larson, Echelle, and Zale 1991; Spain and McKinney 1990). The prairie fish fauna has remnant species adapted to the highly variable flow regimes, turbidity, and extremes of salinity found in prairie rivers, and has incorporated atypical life history strategies in order to survive in an unpredictable and relatively unstable

environment. One reproductive strategy is to time reproduction with increasing streamflow events (Lehtinen and Layzer 1988; Moore 1942; Taylor and Miller 1990). Fish species that are adapted to more moderate stream conditions, such as low to moderate salinity, less turbidity, fewer extremes in water temperature, and smaller flucuations in streamflow regimes, have apparently replaced many of the prairie species either in numerical abundance or are present where the prairie species are rare or absent.

METHODS

Current Species Distributions

Sampling began in October, 1988 and extended through August, 1991 but was limited to summer and fall seasons during these years. Collections (n=37) were made at all known localities of Notropis buccula in the Brazos River basin. Spatial distribution of the sampling sites extended from Garza County downstream to Brazoria County and largely encompassed the entire Brazos River drainage. Ongoing construction of the Alan G. Henry dam prevented sampling the uppermost reaches of the Double Mountain Fork. Two tributaries to the Brazos River were also sampled: Croton Creek (Kent Co.) and Sandy Creek (Stephens Co.). Additionally, the North Wichita River, South Wichita River and Wichita River were sampled in August 1991 to search the sites of historical records of the sharpnose shiner in that river system.

Generally, 4.6 m X 1.3 m (6 mm mesh) and 9.1 m X 1.8 m (9 mm mesh) straight seines were used at each site with sampling at some sites supplemented with a 9.1 m X 1.3 m (6 mm mesh) bag seine. The collection goals were to seine all representative habitats to capture as many fish species as practicable and to record habitat characteristics associated with the seining efforts. For each seine haul a minimum, maximum, and average depth were measured and the substrate type was classified according to a modified Wentworth scale. Channel width was usually measured with a range finder,

measured by tape or estimated and water quality parameters (dissolved oxygen, temperature, specific conductance, and pH) were measured using a Surveyor II Hydrolab or Hydrolab 4041.

Specimens were sacrificed in unbuffered 10% formalin and preserved in 45% isopropyl alcohol. Collections will be deposited at the University of Texas at Austin Memorial Museum Texas Natural Heritage Collection.

Species Historical Distributions

The number of preserved specimens of Notropis buccula and N. oxyrhynchus in major and minor collections is limited based on our survey of collection records and discussions with curators, university faculty and staff associated with the museums and universities in the region. The collections for which specimens or specimen records were surveyed include: University of Kansas Museum of Natural History (KU), Dr. Frank B. Cross and Joseph T. Collins; Tulane University Fish Collection (TU), Dr. Royal Suttkus; Illinois Natural History Collection, Dr. Mike Retzer (while at Texas A&M); University of Texas at Austin Memorial Museum Texas Natural History Collection (UT-TNHC), Dr. Clark Hubbs and Dr. Dean Hendrickson; Texas A&M University Texas Cooperative Wildlife Collection (TAMU), Dr. Kathryn Vaughn and Dr. Mike Retzer; Angelo State University, Dr. Edie Marsh; and University of North Texas, Dr. Earl Zimmerman. Discussions have been held with Dr. Tony

Echelle at Oklahoma State University and Dr. Bill Matthews from the University of Oklahoma, but no formal attempt to survey the collections at those universities has been completed.

Life History

Quantitative habitat measurements were made at one site on the Salt Fork (see Photograph No. 6) on 22 August 1991. Current velocity, depth, and substrate were measured in a grid system comprised of a network of 10 sq. m cells. Within each cell, visual observations of smalleye shiners were made to determine the spatial distribution of individuals, habitat utilization, and basic behavioral characteristics. Current velocity and depth measurements were made with a Montedoro-Whitney flow meter and topsetting wading rod. Substrate was characterized visually using a modified Wentworth scale.

Standard and total lengths (to the nearest mm) were measured on most smalleye and sharpnose shiners collected. Data was used to develop length frequency histograms to provide insight on the population structure of these two species and the sizes attained .

The digestive tracts of 85 smalleye shiners and 64 sharpnose shiners were analyzed from three 1991 collections and one 1992 collection to determine diet. Stomach contents were removed from the digestive tract and sorted into categories as follows:

1) terrestrial invertebrate , 2) aquatic invertebrate, 3) Formicidae (ants), 4) sand/clay/silt, 5) seeds, 6) periphyton, 7) fish, 8) organic matter (detritus) and 9) unidentifiable matter. Percent volumes for each food item were visually estimated. Percent occurrence was calculated as the number of fish with a particular food item divided by the sample size and multiplied by 100.

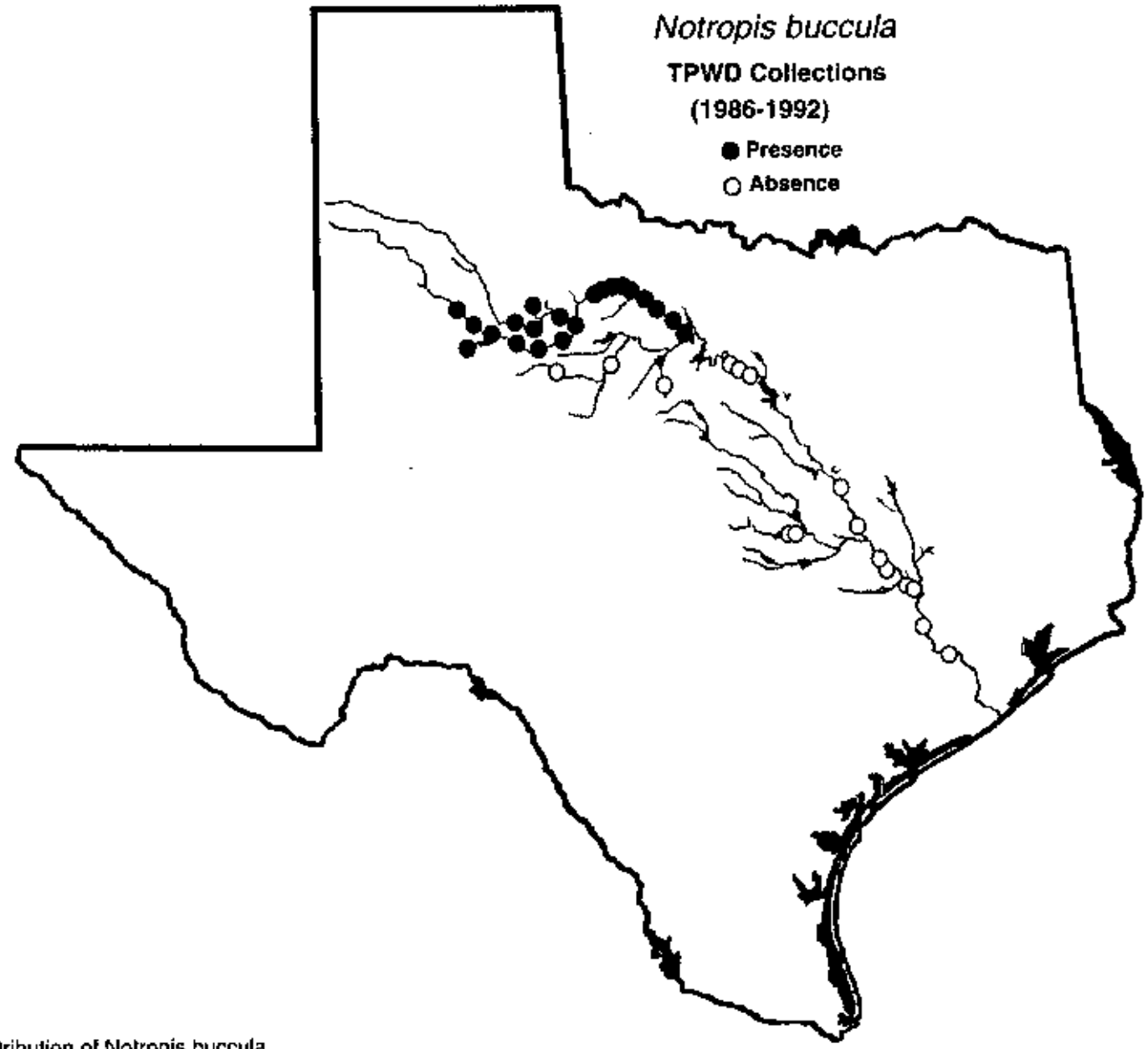
RESULTS

Field Collection Summary

Appendix I provides species and abundance data collected during this study. A total of 26,480 fish represented by 16 families and 55 species were collected from 37 sites in the Brazos River drainage. The most common family encountered, Cyprinidae, was represented by 19 species, followed by Centrarchidae with nine species, and Ictaluridae with five species. By number, cyprinids (18,087) accounted for 68.3% of all individuals collected; cyprinodontids (4,486; three species) accounted for 16.9% and poeciliids (2,582; one species: Gambusia affinis) 9.8% of all individuals collected. The plains minnow, Hybognathus placitus, red shiner, Cyprinella lutrensis, and Red River pupfish, Cyprinodon rubrofluviatilis were the dominant species collected.

Current Distribution

Smalleye shiners were collected from all sites on the Double Mountain Fork and North Fork Double Mountain Fork Brazos River, and Croton Creek (**Map 3**) and all but one collection on the Salt Fork (Stonewall Co: U.S. Hwy 83 on 8 Oct 1988; only Red River pupfish were collected at this extremely saline site (**Appendix V**). Although the historic range of the smalleye shiner extended downstream of Possum Kingdom Reservoir (**Map 1**), none were collected



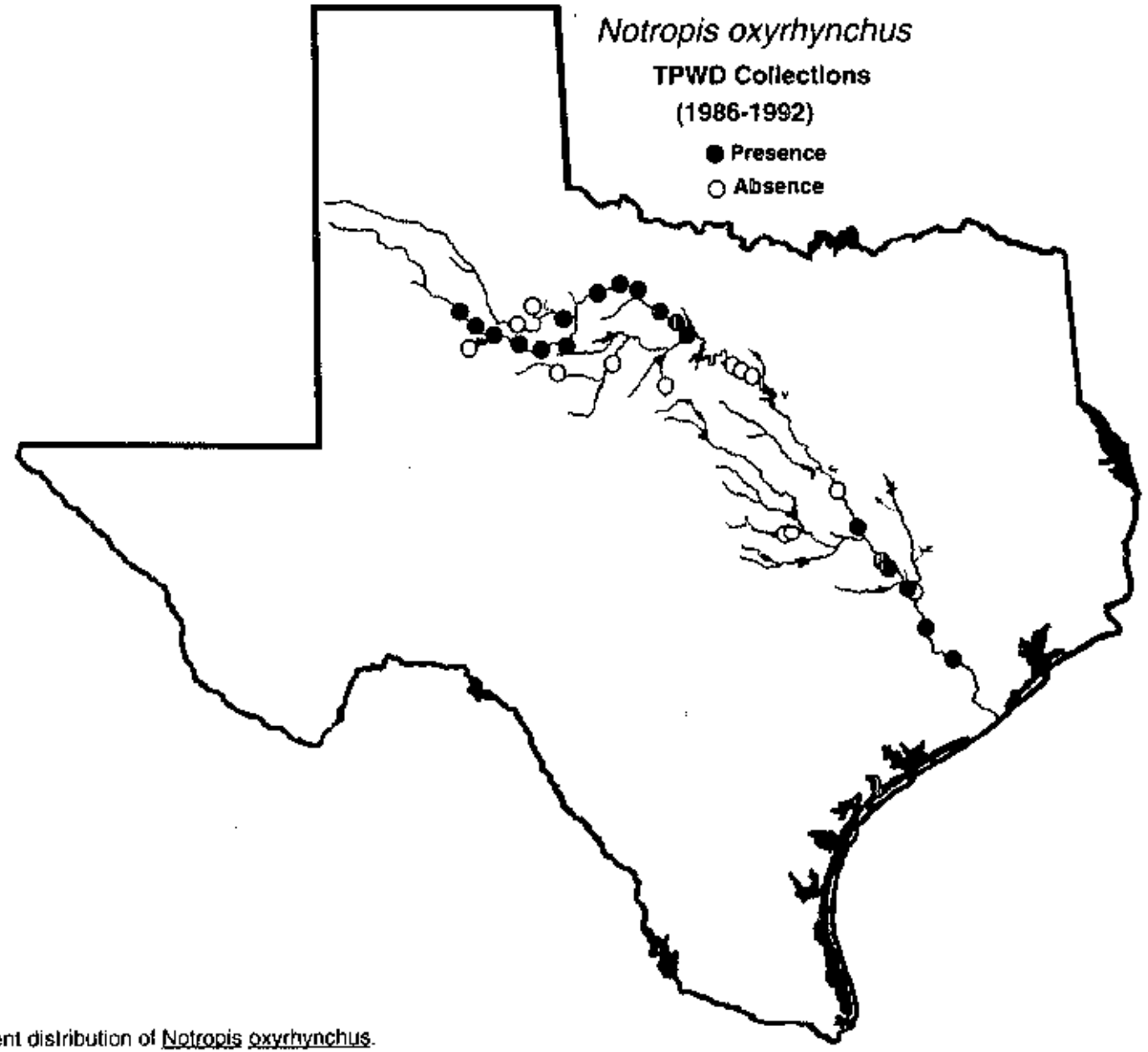
Map 3. Current distribution of Notropis buccula.

from the middle and lower Brazos R. system. A total of 2,388 smalleye shiners were collected from the upper Brazos drainage. Smalleye shiners were among the numerically dominant or most common fishes at eight sites.

Sharpnose shiners were collected from seven sites on the Salt Fork, three sites on the Double Mountain Fork and three sites on the North Fork Double Mountain Fork Brazos River (Map 4). Only 27 specimens, from six sites, were collected downstream of Possum Kingdom Reservoir. A total of 2,083 sharpnose shiners were collected from all sites; sharpnose shiners were among the numerically dominant fishes at four sites, all within the upper Brazos drainage.

Historical Occurrence

The collections surveyed, with some exceptions, have included from few to many errors in the species determinations for N. buccula, based on our examination of specimens. We relied primarily upon the taxonomic keys of G.A. Moore (Blair et al. 1968), Clark Hubbs (Hubbs et al. 1991), the original description by F. B. Cross (Cross 1953), and regional faunal books (Miller and Robison 1973; Robison and Buchanan 1988; and Pflieger 1975). Moore (in Blair et al. 1968) describes the smalleye shiner as similar to N. bairdi but having a smaller mouth, longer snout, and a lesser head depth; pharyngeal teeth 0,4-4,0; anal rays 7; pectoral rays 14-16; nape



Map 4. Current distribution of Notropis oxyrhynchus.

and breast usually naked; and lateral line scales 33-37. The smalleye shiner is geographically separate from the Red River shiner, Notropis bairdi Hubbs and Ortenburger (Cross 1953; Hubbs 1957; Gilbert 1980). The Red River shiner is described by Moore as similar to Notropis girardi, Arkansas River shiner, but with nape and breast usually naked and anal ray count 7. C. Hubbs (Hubbs et al. 1991: 15-16) separates smalleye shiner from the Red River shiner based on snout length greater than distance from anterior tip of mandible to posterior tip of maxillary in N. buccula and shorter in N. bairdi; head depth 15.9 to 17.7 percent of standard length (S.L.) in N. buccula and 17.4 to 19.5 percent in N. bairdi; and opercle length 8 to 9.6 percent of S.L. versus 9.5 to 11.4 of S.L. in N. bairdi.

Most redeterminations of specimens resulted from confusion with similar species such as Notropis potteri (chub shiner), Notropis shumardi (silverband shiner), Notropis stramineus (sand shiner) and others. An example is a distributional study of forage fishes upstream and downstream of Possum Kingdom Reservoir (Anderson 1980; Anderson et al. 1983) in which Notropis stramineus was reported upstream of Possum Kingdom Reservoir in the Brazos River though there are no records for that species extant in the Brazos R. system. Notropis shumardi is distinctly different in body shape, depth of the caudle peduncle, and some fin ray counts. Notropis potteri appears very similar to N. buccula, but can always be distinquished based on tooth count, characteristic mouth features

(broadened upper lip posteriorly), and patterns of squamation. **Appendix III** provides photographs taken of specimens to demonstrate the similarities and differences from the closely related shiners (N. buccula, N. bairdi, and N. girardi) and other species that have similar superficial appearances (N. potteri).

Notropis oxyrhynchus Hubbs and Bonham is perhaps easier to distinguish because of its characteristic sharp head and long snout, but some misidentifications of N. oxyrhynchus were present in museum and fish collections. One remaining specimen of concern is a single fish collected from the upper Colorado River drainage in Texas and preserved as UT-TNHC 2500 (see **Photograph 10**). This specimen has many features that conform with N. oxyrhynchus but has a shorter preorbital head length, a deeper caudal peduncle than expected, and is the sole specimen attributed to N. oxyrhynchus from the Colorado R. drainage. While it has been assumed to be an introduction (Gilbert 1980), it could be a slightly aberrant specimen.

While there will always be additional collections being made, further examination of existing fish collection records may refine the historical and current distributions of smalleye shiners and sharpnose shiners.

The presence of preserved specimens in museum collections is relatively limited for both Notropis buccula and Notropis

oxyrhynchus. Gilbert (1980) mapped and summarized the distributions for both species as well as for Notropis bairdi. While the general distributions mapped by Gilbert for these species is correct, an intensive search of museum records and fish collections has resulted in more localities within the known range. The historical distribution for N. buccula based on all known museum voucher specimens and other fish collections is summarized in Table 1 and **Map 1.** The smalleye shiner, based on collections before 1986, was known from eleven Brazos River mainstem sites and an additional site on the Lampassas River south of Belton. The distribution for N. oxyrhynchus from fish collections and museum specimens is summarized in Table 2 and **Map 2.** The sharpnose shiner, based on collections before 1986, was known from seventeen mainstem sites (including near the confluence of the Navasota River with the Brazo R.) and had also been found at two sites in the Wichita River drainage. As referenced earlier, the Colorado River mainstream specimen has unresolved questions about its identity. Sharpnose shiners historically may have ranged further downstream in the Brazos River drainage based on Fort Bend County records.

Life History Information

A summary of physical and chemical characteristics of smalleye and sharpnose shiner collection sites is provided in Table 3. Water quality data measured from all sites during this study are presented for reference in **Appendix V.** Smalleye and sharpnose

Table 1. Master list of collection sites for Notropis buccula.

State	County	Locality	Collectors	Date	No. Spec.	Museum No.
TX	Garza	North Fork Double Mountain Fork Brazos River at SH 207 N Post	K. Mayes and J. Glass	14 May 1992	53	N/A
TX	Garza	North Fork Double Mountain Fork Brazos River at FM 651	R. Wahl, A. Price and R. Murphy	29 Jul 1986	74	UT 12249
TX	Garza	North Fork Double Mountain Fork Brazos River at FM 651 NE Post	K. Mayes and J. Glass	14 May 1992	62	N/A
TX	Garza	North Fork Double Mountain Fork Brazos River at US 380 E Post	R. Moss, K. Mayes, and K. Saunders	21 Aug 1991	42	N/A
TX	Garza	Double Mountain Fork Brazos River at SH 84 Justiceburg	Garrett, Garratt, and D. Mosier	11 Mar 1978	35	N/A
TX	Garza	Double Mountain Fork Brazos River at SH 84 Justiceburg	K. Mayes and J. Glass	14 May 1992	21	N/A
TX	Kent	Double Mountain Fork Brazos River at SH 208	R. Wahl, A. Price, and R. Murphy	28 Jul 1986	12	TU 12133
TX	Kent	Double Mountain Fork Brazos River at SH 208 S Clairemont	R. Moss, E. Marsh, K. Mayes, and S. Jones	15 Aug 1989	469	N/A
TX	Fisher	Double Mountain Fork Brazos River at SH 70	R. Murphy, A. Price, and R. Wahl	29 Jul 1986	46	UT 12183
TX	Fisher	Double Mountain Fork Brazos River at SH 70 N Rotan	R. Moss, K. Mayes, and K. Saunders	22 Aug 1991	211	N/A
TX	Stonewall	Double Mountain Fork Brazos River at US 83 11.3 mi S Aspermont	R.S. Suttkus, Negus, Gould, and Shoop			TU 20223
TX	Stonewall	Double Mountain Fork Brazos River at US 83 S Aspermont	R. Moss, E. Marsh, K. Mayes, and S. Jones	15 Aug 1989	303	N/A
TX	Stonewall	Double Mountain Fork Brazos River at SH 283	R. Wahl, A. Price, and R. Murphy	30 Jul 1986	157	UT 12245
TX	Haskell	Double Mountain Fork Brazos River at US 380	R. Murphy, A. Price, and R. Wahl	30 Jul 1986	101	UT 12211
TX	Kent	Salt Fork Brazos River 12 mi W Jayton	Arden L Walker	25 Mar 1960		TU 39869
TX	Kent	Salt Fork Brazos River at SH 208	R. Wahl, A. Price, and R. Murphy	28 Jul 1986	1	UT 12239
TX	Kent	Salt Fork Brazos River (at US 380) 6 mi SW Jayton	F.T. Knapp and class	14 Oct 1951	5	TAMU 1094
TX	Kent	Salt Fork Brazos River at US 380 SW Jayton	R. Moss, R. Kleinsasser, and R. Wahl	8 Oct 1988	69	N/A
TX	Kent	Croton Creek at County Rd N Jayton	G. Linam and J. Glass	15 Aug 1989	25	N/A
TX	Stonewall	Salt Fork Brazos River at US 380 between Jayton and Swenson	R. Wahl, A. Price, and R. Murphy	29 Jul 1986	70	UT 12179
TX	Stonewall	Salt Fork Brazos River at US 83 N Aspermont	R. Moss, K. Mayes, and K. Saunders	23 Aug 1991	12	N/A
TX	Knox	Salt Fork Brazos River at SH 222	R. Wahl, R. Murphy, and A. Price	31 Jul 1986	45 + 16	UT 12150+12151
TX	Knox	Salt Fork Brazos River at SH 222 W Knox City	R. Moss, R. Kleinsasser, and R. Wahl	9 Oct 1988	96	N/A
TX	Knox	Salt Fork Brazos River at SH 222 W Knox City	R. Moss, K. Mayes, and K. Saunders	23 Aug 1991	172	N/A
TX	Knox	(Salt Fork) Brazos River (at SH 6) 5 mi S Benjamin	F.B. Cross, W.W. Dalquest, and L. Lewis	27 Sep 1953	71	KU 3077
TX	Knox	(Salt Fork) Brazos River at SH 6 under RR bridge abutment	R. Murphy, A. Price, and R. Wahl	31 Jul 1986	43	UT 12200
TX	Knox	Salt Fork Brazos River 2 mi N Rineland at crossing of FM 267	F.T. Knapp	Oct 1951	6	INHC 83346
TX	Knox	Salt Fork Brazos River at FM 267	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	4	UT 12105
TX	Knox	Salt Fork Brazos River at FM 267 N Rineland	R. Moss, R. Kleinsasser, and R. Wahl	9 Oct 1988	91	N/A
TX	Baylor	Salt Fork Brazos River on Route 277 near Seymour	Retzer, Page, Cummings, and Swanson	28 Jul 1984	2	TAMU 3908
TX	Baylor	Salt Fork Brazos River at US 183/283 Seymour	R. Moss and R. Wahl	9 Oct 1988	49	N/A
TX	Baylor	Salt Fork Brazos River at US 183/283 Seymour	R. Moss and K. Mayes	16/17 Aug 1989	122	N/A
TX	Baylor	Salt Fork Brazos River near Round Timber Cemetary, conf. w/ Wagon Cr	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	6 + 17	UT 12163+12223
TX	Young	Salt Fork Brazos River at SH 79	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	8	UT 12219
TX	Young	Salt Fork Brazos River at SH 79 E Elbert	R. Moss and R. Wahl	10 Oct 1988	39	N/A
TX	Young	Salt Fork Brazos River at SH 79 E Elbert	R. Kleinsasser, G. Linam, and S. Jones	19 Jul 1990	91	N/A
TX	Young	Salt Fork Brazos River at TX 24 1.5 mi W Newcastle	Kuris and Clark	28 Mar 1968	188	TU 92596
TX	Young	Salt Fork Brazos River at US 380 W Newcastle	R. Kleinsasser, G. Linam, and S. Jones	19 Jul 1990	21	N/A
TX	Young	Salt Fork Brazos River at US 380 W Newcastle	R. Moss, K. Mayes, and K. Saunders	24 Aug 1991	467	N/A
TX	Young	Salt Fork Brazos River at FM 209	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	8	UT 12158
TX	Young	Salt Fork Brazos River at FM 209 S Newcastle	R. Kleinsasser, G. Linam, and S. Jones	19 Jul 1990	4	N/A
TX	Young	Brazos River at SH 67	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	1	UT
TX	Palo Pinto	(Veale Creek Arm) Possum Kingdom Lake	J. Riggs and J. Walker	24 Mar 1951	9	TNHC 1256
TX	Palo Pinto	Brazos River on US 281 7 mi S Mineral Wells	G.A. Moore and F.B. Cross	14 April 1952	16	KU 2318
TX	Palo Pinto	Brazos River 11 mi S Mineral Wells	G.A. Moore and F.B. Cross	14 April 1952	1	KU 2642
TX	Bosque	Tributary (?) to Brazos River 4.0 mi S Whitney Dam	R.D. Suttkus and Anderson	8 Apr 1952	16	TU 4993

Table 1. continued

State	County	Locality	Collectors	Date	No. Spec.	Museum No.
TX	Bell	Lampasas River S Belton at Station 14	F.T. Knapp and class	13 Oct 1951	5	TAMU 0164
TX	Brazos/Burleson	Brazos River	J.V. Conner	26 Oct 1965	1	TAMU 1216
TX	Brazos/Burleson	Brazos River	311 class	30 Oct 1965	1	TAMU 1217
TX	Brazos	Brazos River 5 mi W College Station	K. Bonham and G.E. Spofford		9	TAMU 1220
TX	Brazos	Brazos River near Bryan	F.B. Cross, A. Bjelland, L. Cavin, and J. Laswell	25 Apr 1970	20	KU 14286
TX	Brazos	Brazos River at "Mussel Shoals" end of FM 1688 8 mi W of Bryan	J.V. Conner and R. Hodson	31 Dec 1970	15	TU 69572
TX	Brazos	Brazos River at "Mussel Shoals" end of FM 1688 8 mi W of Bryan	J.V. Conner, R. Hodson, and L. Martin	21 Apr 1971	25	TU 69528
TX	Brazos	Brazos River at "Mussel Shoals" end of FM 1688 8 mi W of Bryan		6 Feb 1976	3	TAMU 0938

Table 2. Master list of collection sites for Notropis oxyrhynchus.

State	County	Locality	Collectors	Date	No. Spec.	Museum No.
TX	Garza	North Fork Double Mountain Fork Brazos River at SH 207 N Post	K. Mayes and J. Glass	14 May 1992	10	N/A
TX	Garza	North Fork Double Mountain Fork Brazos River at FM 651 NE Post	K. Mayes and J. Glass	14 May 1992	129	N/A
TX	Garza	North Fork Double Mountain Fork Brazos River at US 380 E Post	R. Moss, K. Mayes, and K. Saunders	21 Aug 1991	26	N/A
TX	Kent	Double Mountain Fork Brazos River at SH 208	R. Wahl, A. Price, and R. Murphy	28 Jul 1986	7	UT 12129
TX	Kent	Double Mountain Fork Brazos River at SH 208 S Clairemont	R. Moss, E. Marsh, K. Mayes, and S. Jones	15 Aug 1989	8	N/A
TX	Fisher	Double Mountain Fork Brazos River at SH 70 N Roten	F.T. Knapp and class	14 Oct 1951	165	TAMU 1095
TX	Fisher	Double Mountain Fork Brazos River at SH 70	R. Murphy, A. Price, and R. Wahl	29 Jul 1986	3	UT 12186
TX	Fisher	Double Mountain Fork Brazos River at SH 70 N Roten	R. Moss, K. Mayes, and K. Saunders	22 Aug 1991	47	N/A
TX	Stonewall	Double Mountain Fork Brazos River at US 83 S Aspermont	R. Moss, E. Marsh, K. Mayes, and S. Jones	15 Aug 1989	697	N/A
TX	Haskell	Double Mountain Fork Brazos River at US 380	R. Murphy, A. Price, and R. Wahl	30 Jul 1986	2	UT 12210
TX	Kent	Salt Fork Brazos River 6 mi SW Jayton	F.T. Knapp and class	14 Oct 1951	5	TAMU 1094
TX	Stonewall	Salt Fork Brazos River at US 83 N Aspermont	R. Moss, K. Mayes, and K. Saunders	23 Aug 1991	4	N/A
TX	Knox	Salt Fork Brazos River at SH 222	R. Wahl, R. Murphy, and A. Price	31 Jul 1986	23	UT 12153
TX	Knox	Salt Fork Brazos River at SH 222 W Knox City	R. Moss, R. Kleinsasser, and R. Wahl	9 Oct 1988	21	N/A
TX	Knox	Salt Fork Brazos River at SH 222 W Knox City	R. Moss, K. Mayes, and K. Saunders	23 Aug 1991	48	N/A
TX	Knox	(Salt Fork) Brazos River (at SH 6) 5 mi S Benjamin	F.B. Cross, W.W. Dalquest, and L. Lewis	27 Sep 1953	236	KU 3079
TX	Knox	(Salt Fork) Brazos River at SH 6 under RR bridge abutment	R. Murphy, A. Price, and R. Wahl	31 Jul 1986	20	UT 12206
TX	Knox	Salt Fork Brazos River at FM 267	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	4	UT 12106
TX	Knox	Salt Fork Brazos River at FM 267 N Rhineland	R. Moss, R. Kleinsasser, and R. Wahl	9 Oct 1988	15	N/A
TX	Baylor	Salt Fork Brazos River at US 183/283 Seymour at Station 41	F.T. Knapp and class	13 Oct 1951	137	TAMU 0159
TX	Baylor	Salt Fork Brazos River on Route 277 near Seymour	Retzer, Page, Cummings, and Swanson	28 Jul 1984	11	TAMU 3908
TX	Baylor	Salt Fork Brazos River at US 183/283 Seymour	R. Moss and R. Wahl	9 Oct 1988	15	N/A
TX	Baylor	Salt Fork Brazos River at US 183/283 Seymour	R. Moss and K. Mayes	16/17 Aug 1989	598	N/A
TX	Baylor	Salt Fork Brazos River near Round Timber Cemetery, confluence w/ Wagon Cr	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	137 + 27 + 136	UT 12119 + 12159 + 12181
TX	Young	Salt Fork Brazos River at SH 79	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	71	UT 12218
TX	Young	Salt Fork Brazos River at SH 79 E Elbert	R. Moss and R. Wahl	10 Oct 1988	70	N/A
TX	Young	Salt Fork Brazos River at US 380 W Newcastle	R. Kleinsasser, G. Linam, and S. Jones	19 Jul 1990	139	N/A
TX	Young	Salt Fork Brazos River at US 380 W Newcastle	R. Moss, K. Mayes, and K. Saunders	24 Aug 1991	79	N/A
TX	Young	Salt Fork Brazos River at FM 209	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	374	UT 12152
TX	Young	Salt Fork Brazos River at FM 209 S Newcastle	R. Kleinsasser, G. Linam, and S. Jones	19 Jul 1990	150	N/A
TX	Young	Brazos River at SH 67 700 yd south 8 mi SSW Graham	J. Riggs et al.	24 Mar 1951	7	UT 1259
TX	Young	Brazos River at SH 67	R. Wahl, A. Price, and R. Murphy	31 Jul 1986	17	UT 12139
TX	Palo Pinto	(Veale Creek Arm) Possum Kingdom Lake	J. Riggs and J. Walker	23 Mar 1951	35	UT 1257
TX	Palo Pinto	Brazos River on US 281 7 mi S Mineral Wells	G.A. Moore and F.B. Cross	14 April 1952	32	KU 2316
TX	Somervell	Brazos River 5 mi E Glen Rose	F.T. Knapp and class	15 Oct 1951	6	TAMU 1109
TX	Bosque	Brazos River 200 yd below Whitney Dam at Station 22	F.T. Knapp and class	14 Oct 1951	43	TAMU 0177
TX	Bosque	Brazos River 5 mi SE Whitney Dam	C.S. Hubbs and K. Strawn	25 Jun 1953	3	UT 4217
TX	McLennan	Brazos River 12 mi NW Waco	C.S. Hubbs and K. Strawn	24 Jun 1953	38	UT 3453
TX	Robertson	Brazos River 5 mi W Hearne	Page, Retzer, Swanson, and Cummings	25 Jul 1984	3	TAMU 3906
TX	Milam	Brazos River at FM 485 W Hearne	K. Mayes and K. Saunders	10 Jul 1991	1	N/A
TX	Brazos	Brazos River 1.8 mi S on SH 21 on Leon Cash Ranch	J.M. Davis	7 Nov 1964	242	TAMU 1106
TX	Brazos	Brazos River 1.5 mi upstream of "Mussel Shoals" W College Station	R. Moss, K. Mayes, and K. Saunders	1 Aug 1991	1	N/A
TX	Brazos	Brazos River	311 class	17 Oct 1965	146	TAMU 1257
TX	Brazos/Burleson	Brazos River east of "Mussel Shoals" 8 mi W Bryan end of FM 1688	Connor and class	11 Mar 1967	5	TAMU 0346

Table 2. continued

State	County	Locality	Collectors	Date	No. Spec.	Museum No.
TX	Brazos	Brazos River near Bryan		25 Apr 1970	9	KU 14288
TX	Brazos	Brazos River at FM 1688 at "Mussel Shoals" W College Station		6 Feb 1976	20	TAMU 0938
TX	Brazos	Brazos River	311 class	21 Feb 1977	227	TAMU 1171
TX	Brazos	Brazos River at FM 1688 at "Mussel Shoals" W College Station	R. Moss, K. Mayes, and K. Saunders	1 Aug 1991	3	N/A
TX	Brazos	Brazos River at Hidalgo Falls off FM 159 W Navasota	R. Moss, K. Mayes, and K. Saunders	3 Jul 1991	10	N/A
TX	Grimes	Brazos River 5.8 mi W traffic light in Navasota	Phillips et al.	23 Feb 1952	27	UT 2544
TX	Waller	Brazos River 5 mi W Hempstead	C.S. Hubbs et al.	13 Jul 1953	140	UT 4296
TX	Waller/Washington	Brazos River 5 mi W Hempstead	C.S. Hubbs, N. Morales, and M. Bowen	14 Jul 1986	9	UT 15596
TX	Austin	Brazos River at Raccon Bend Oil Field Rd off FM 331 S Hempstead	K. Mayes and K. Saunders	24 Jul 1991	5	N/A
TX	Fort Bend	Brazos River at FM 1093 E Simonton	K. Mayes and K. Saunders	23 Jul 1991	7	N/A
TX	Fort Bend	Brazos River at US 90A Richmond	F.T. Knapp and class	15 Oct 1951	387	TAMU 0967
TX	Knox	South Fork Wichita River 5 mi N Benjamin	F. Cross, W. Dalquest, and L. Lewis	27 Sep 1953	8	KU 3073
TX	Foard	North Fork Wichita River 10 mi W Crowell		4 Jan 1955	1	KU 3405

Table 3. Summary of physical habitat characteristics and water quality parameters taken at Notropis buccula and N. oxyrhynchus collection sites on the Brazos River. Refer to **Appendix V** for physicochemical data taken at other sites. Sample size given in parenthesis.

	N. buccula	N. oxyrhynchus
Grand Mean Depth (cm)	20 (82)	24 (110)
Mean Minimum Depth (cm)	5 (38)	5 (38)
Mean Maximum Depth (cm)	33 (82)	39 (82)
Mean Channel Width (m) (Range)	42 25 – 67 (8)	59 25 – 137 (10)
Mean Dissolved Oxygen (mg/L) (Range)	6.9 5.8 – 7.7 (7)	7.1 5.8 – 7.6 (9)
Mean Water Temperature (C) (Range)	29.4 24.8 – 34.7 (10)	30.0 26.0 – 34.7 (12)
Mean Specific Conductance (µmho/cm) (Range)	6216 1133 – 24000 (10)	4608 897 – 24000 (12)

shiners tend to occur in fairly shallow water as indicated by the mean minimum and maximum depths (Table 3). Mean specific conductance at N. buccula and N. oxyrhynchus collection sites were 6216 and 4608 μmhos/cm, respectively. Water temperature and specific conductance maxima for all collections were 34.7 C and 24000 μmhos/cm (Table 3). Substrates at collection sites of smalleye shiners were predominantly sand or silt over sand. A few sites had substrates consisting of sand and small gravel. Substrates at sharpnose shiner collection sites were predominantly sand as well, however, a few sites in the lower Brazos system were characterized by large gravel and cobble (e.g. Hidalgo Falls in Brazos Co.). Substrates at sites downstream of mainstem impoundments were predominantly cobble and larger substrates.

Habitat Utilization

The sampling site on the Salt Fork of the Brazos River was selected because the relatively abundant presence of Notropis buccula had been confirmed from a previous collection at the site in 1989. By making observations in late summer (August, 1991), streamflow conditions were a limiting habitat factor for smalleye shiners and other species present (Hybognathus placitus, plains minnow; Cyprinodon rubrofluviatilis, Red River pupfish; and Fundulus zebrinus, plains killifish). From the grid of 10 sq. m cells, the habitat utilization by all fish species present was related to flow velocities, water depths, substrate type present, and any features

of cover (logs, debris, etc.). Smalleye shiners (n = 276) were observed and enumerated from 59 cells and did not utilize habitat that had flow velocities less than 0.1 feet per second (fps). At least some N. buccula were recorded from all velocities greater than 0.1 fps up to the maximum velocity (1.3 fps) present in the sampled area (Figure 1). Smalleye shiners school and are also usually aggregated during feeding, so habitat utilization was based on presence/absence rather than on the numerical abundance within each cell. Because of the limitation of few observations, less than complete habitat utilization for some flow velocities (> 0.1 fps) is probably an artifact of sampling. The same limitation also applies to water depth. Notropis buccula avoided shallow water toward the river's edge (less than 0.1 ft.) and were most common in depths from 0.3 ft. to 0.7 ft. (Figure 2), but depths greater than 0.8 ft. were scarce in the study area. The edges of the channel had silt or silt over sand as primary substrate types and were avoided by smalleye shiners (Figure 3). The greatest habitat utilization occurred over clean sand or sand with only a minor silt component.

Most presentations of habitat utilization data are single habitat features (i.e. water velocity or depth) versus the utilization by a single species (Bovee 1986), but it really can be more descriptive and useful to consider habitat as a combination of interactions. For example, smalleye shiners utilized the broad center of the river channel (and avoid shallow edges) where

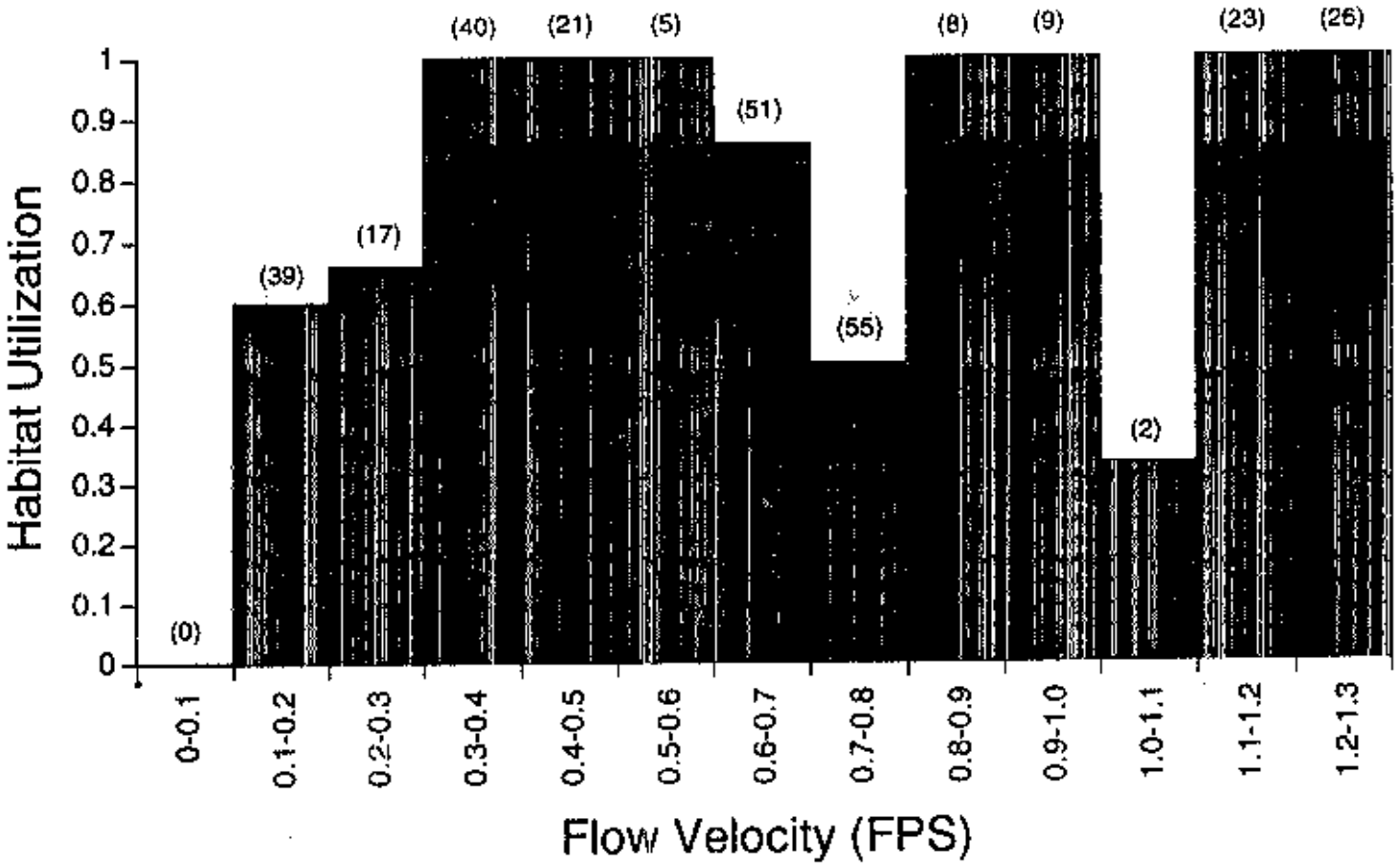


Figure 1. Presence of Notropis buccula in streamflow velocities from a grid of habitat cells in the Salt Fork of the Brazos River (see Photograph 5) based upon 59 observations of 276 fish. Values inside parentheses indicate number of fish observed.

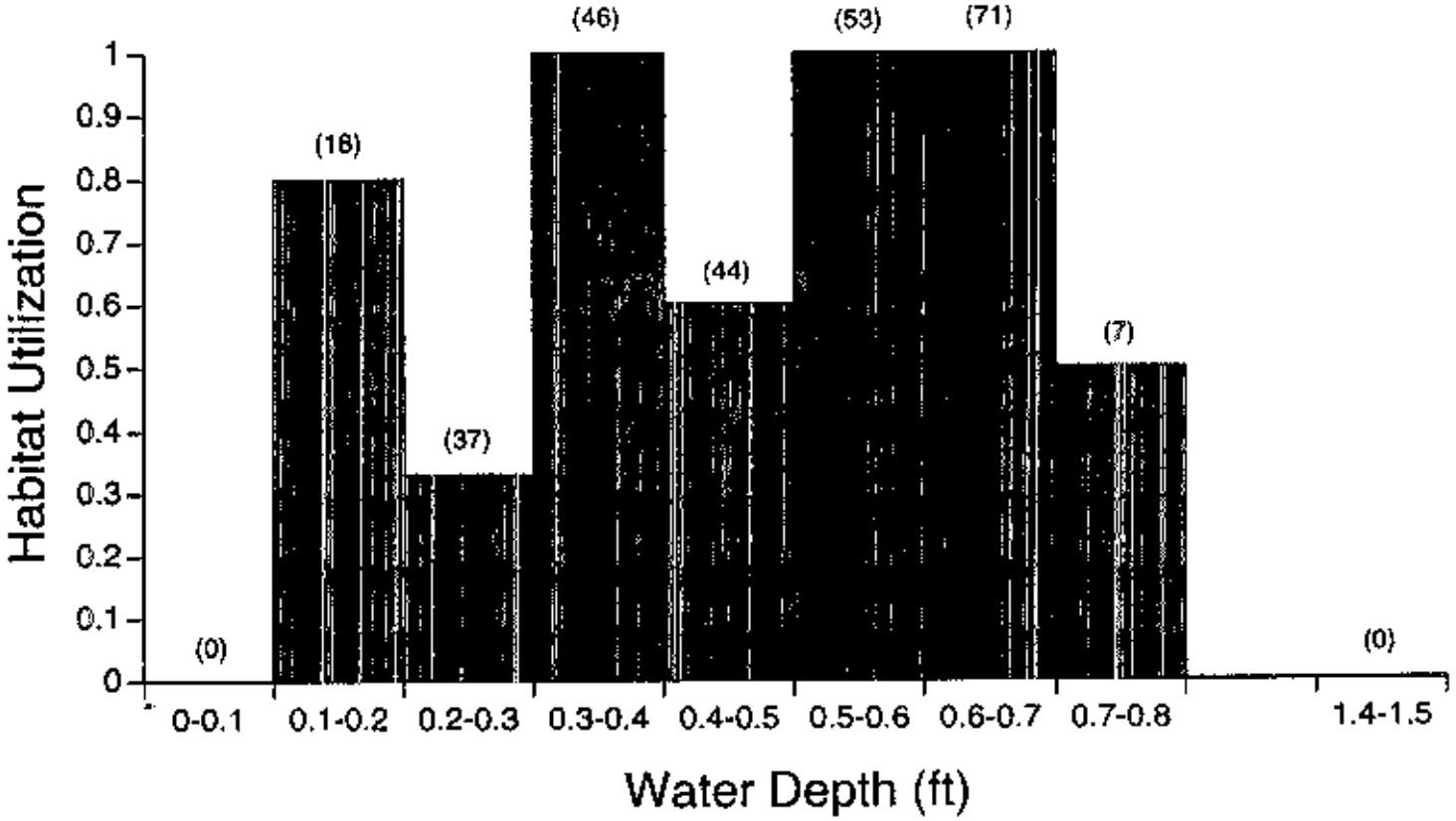


Figure 2. Presence of Notropis buccula in water depths from a grid of habitat cells in the Salt Fork of the Brazos River (see Photograph 5) based upon 59 observations of 276 fish. Values inside parentheses indicate number of fish observed.

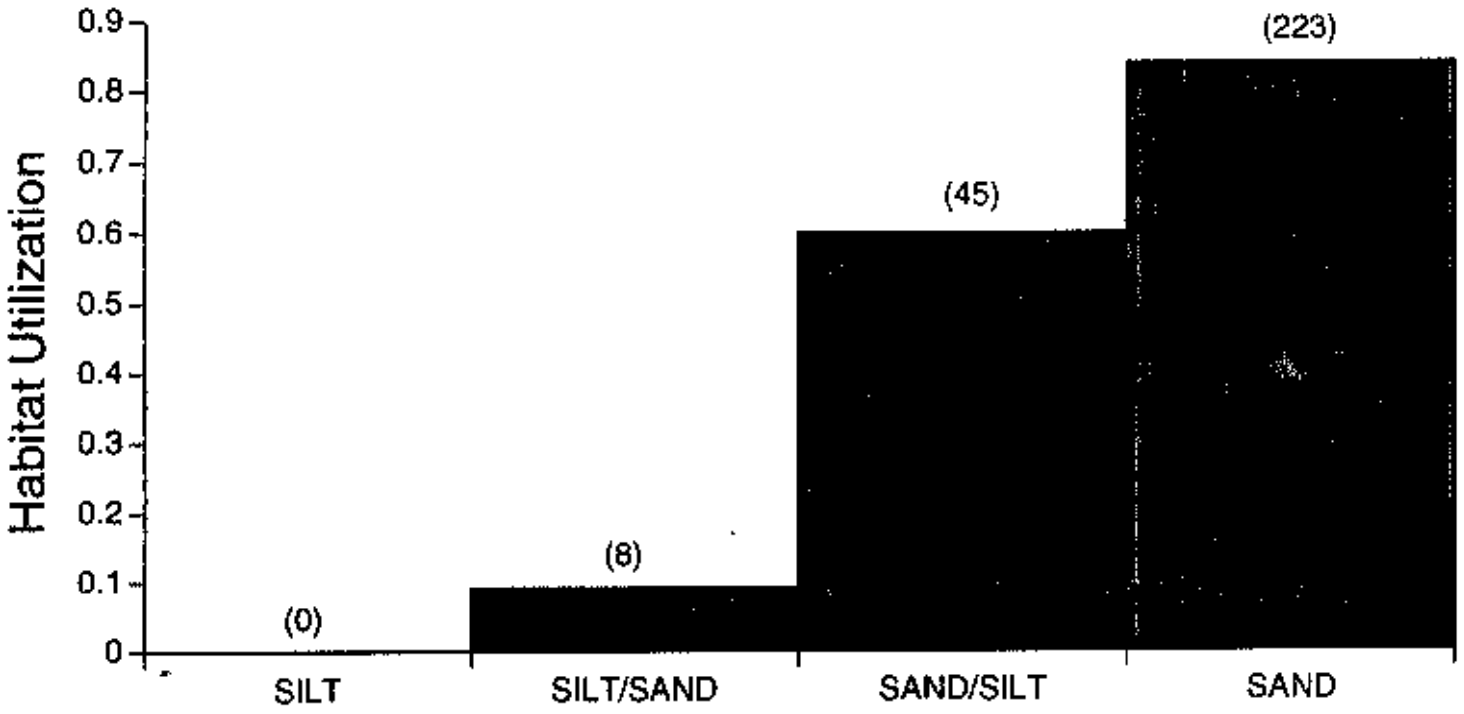


Figure 3. Presence of Notropis buccula over substrates from a grid of habitat cells in the Salt Fork of the Brazos River (see Photograph 5) based upon 59 observations of 276 fish. Values inside parentheses indicate number of fish observed.

moderate currents kept sand bottoms swept relatively clean of depositional silt (see **Photograph 5**) and provided velocities requiring only minimal expenditures of energy for swimming. On the other hand, Red River pupfish (especially juveniles) were observed in river edge areas with substantial silt present because of reduced current. As depth and current increased slightly, plains minnows became common. While there was always habitat overlap between species, as more current caused less silt and depth increased, plains killifish were increasingly abundant.

Length frequency histograms were prepared from representative samples of smalleye and sharpnose shiners (**Appendix IV**: Figures 4-10 for N. buccula; and Figures 11-14 for N. oxyrhynchus). Length frequency histograms for N. buccula are distinctly bimodal (Figures 7 and 8). Gravid females of both species were collected in the months of May, July, and August.

Stomach items found in N. buccula specimens examined ranged from terrestrial invertebrates to organic particulates to sand (Table 4). Stomach contents consisted mainly of sand and terrestrial and aquatic invertebrates (Table 5). The dominant item consumed by smalleye shiners was sand; the volume of sand in 37 individuals exceeded 90 percent (mean volume 64%) and was present in 82 percent of individuals examined. Terrestrial invertebrates and aquatic invertebrates were found in 73 and 44 percent of individuals examined. Dipteran adults were the dominant terrestrial

Table 4. Food items found in Notropis buccula (n=85) from the Brazos River. Specimens examined were from TPWD collections from 1991 and 1992.

Terrestrial Invertebrate
Coleoptera
Diptera
Hemiptera
Hymenoptera
Aquatic Invertebrate
Diptera
Ceratopogonidae larvae
Chironomidae larvae
Tipulidae larvae
Coleoptera larvae
Copepoda (Harpacticoid)
Ephemeroptera nymphs
Hydracarina
Trichoptera larvae
Sand, Clay, and Silt
Seeds
Periphyton (Diatoms and Filamentous Algae)
Larval Fish
Particulate Organic Matter

Table 5. Percent volume of food items found in Notropis buccula (n=85).

Standard Length (mm)	Terrestrial Insects	Aquatic Insects	Sand/Clay	Ants	Seeds	Organic Matter	Periphyton	Fish
15	25		74			1		
15	20		60		10	10		
16	5		95					
16	5		95					
16		1	99					
16	100							
17	25		75					
17	1		99					
17	10		85			5		
17	45	5			50			
18	40	1	56			2		
20	1	1	96		1	1		
20			95		5			
20		1	94			5		
21	70		28				2	
21	1		99					
23	5	2	92			1		
23	30		70					
24	1		98			1		
24	90		10					
25			100					
27		3	95				2	
27	1		99					
27	1		94			5		
27		60	40					
27		1	78			1		20
28		5	95					
28		1	99					
29			99			1		
29		1	99					
30	45	45	10					
30			100					
31		2	98					
32	80		20					
32		40	60					
32		2	95				3	
34		30	70					
34	40	40	10		10			
35	5		95					
35	1		98	1				
37	45		5		50			
37		20	10			70		
37	10		90					
38			100					
39	10	50	40					

Table 5. Continued.

Standard Length (mm)	Terrestrial Insects	Aquatic Insects	Sand/Clay	Ants	Seeds	Organic Matter	Periphyton	Fish
39	10	10	70			10		
40				25	75			
41	35		5	10		50		
42			100					
42		1	98	1				
43	1		98	1				
43	95			3	2			
43	10	90						
44	40	2	3	55				
45	90	3	5		2			
45		3	95		2			
45	100							
45	3		95		2			
45	80		20					
46	20		80					
46	90	1	9					
46			95	1			4	
46	40		10	50				
46	20	30	10		40			
47	8	2				90		
47	95			3	2			
48	85			15				
48	5	10			85			
48	93			5	2			
49			100					
49	100							
49	70	5	25					
50	5				95			
50	60	10	20			10		
50	95		5					
50	80		15	5				
51	100							
51			100					
52			95			1	4	
53	100							
53	59	1			40			
53	100							
53	80	15	5					
54	99		1					
55		3	95				2	
No. Individuals	62	37	70	15	20	19	7	2
Occurrence	73	44	82	18	24	22	8	2
ean Volume	42	13	64	12	24	14	2	10
Range	1-100	1-90	1-100	1-55	1-95	1-90	2-4	

invertebrate while chironomid larvae were the most common aquatic invertebrates consumed.

Stomach items found in N. oxyrhynchus specimens ranged from terrestrial insects to seeds (Table 6). The most numerous item consumed was terrestrial invertebrates (mainly dipteran adults); aquatic invertebrates, sand, and seeds were also ingested but less commonly than terrestrial insects (Table 7).

Table 6. Food items found in Notropis oxyrhynchus (n=64) from the Brazos River. Specimens examined were from TPWD collections from 1991 and 1992.

Terrestrial Invertebrate
Arachnida
Coleoptera
Diptera
Hemiptera
Hymenoptera
Thysanoptera (Thrips)
Aquatic Invertebrate
Diptera
Chironomidae larvae
Cladocera
Coleoptera larvae
Ephemeroptera nymphs
Hydracarina
Sand, Clay, and Silt
Seeds
Fish Scales
Particulate Organic Matter
Unidentifiable Matter

Table 7. Percent volume of food items found in Notropis oxyrhynchus (n=64).

Standard Length (mm)	Terrestrial Insects	Aquatic Insects	Sand/Clay	Ants	Seeds	Organic Matter	Fish	Unidentified Matter
18	90	5				5		
19	80		20					
20		90	5			5		
20		70			5	25		
20	95		5					
20		30	10		50	10		
20		80	5			15		
21		5				95		
21	50		30			20		
22	50		50					
22	50		50					
23		5	5					90
24	1		95			4		
24			80			20		
25		5	5			90		
25	85			15				
25			100					
26	5	5	85			5		
27	5		95					
29		20	40			30	10	
30			80				20	
30	20		60			20		
32	100							
32	100							
32	100							
33	20		80					
33	48	1		50	1			
33	70				30			
33	98				2			
33	99				1			
34	70		20		10			
34	90				10			
35	1				99			
35	70			30				
36	5		95					
36	50	5		45				
36	97			3				
36	98	1			1			
36	100							
36	100							
36	100							
37	97				3			
37	100							
37	100							
37	100							

Table 7. Continued.

Standard Length (mm)	Terrestrial Insects	Aquatic Insects	Sand/Clay	Ants	Seeds	Organic Matter	Fish	Unidentified Matter
37	100							
38	14	1	60	20		5		
38	40		60					
38	95			5				
38	96	3			1			
38	97	3						
38	100							
38	100							
39	99			1				
39	100							
40	75			15	10			
40	100							
42	95				5			
42	100							
43	10				90			
43	80				20			
45	94	5			1			
47	95			5				
47	99	1						
No. Individuals	55	22	24	11	18	16	3	3
% Occurrence	65	26	28	13	21	19	4	4
Mean Volume	72	15	47	17	19	22	10	30
Range	1-100	1-90	5-100	1-50	1-99	4-90	10-20	90

DISCUSSION

Diet of smalleye shiners consisted mainly of sand and invertebrates. Ingestion of sand and aquatic invertebrates is related to the bottom-feeding habits of this shiner. Observations in the grid system corroborate this behavior; feeding strikes at small invertebrates or food particles were observed when those items were uncovered by the continuously shifting sand. The mouth of N. buccula is nearly horizontal, a morphological adaptation for feeding near the substrate. The nutritional content of sand itself is minimal and the ingestion of sand by the smalleye shiner is probably incidental to the shiner's feeding habits. However, some nutritional content might be derived from bacteria and/or diatoms colonized on surfaces of sand particles. Based upon the stomach contents analysis and visual observations, N. buccula appears to be an opportunistic invertebrate feeder.

Notropis oxyrhynchus should also be considered an opportunistic invertebrate feeder. The diet of this shiner was predominantly terrestrial insects, with most probably taken from the surface of the water. The sharpnose shiner mouth is very oblique, so surface feeding behavior is not surprising. Several stomachs contained seeds, thrips, small spiders, ants, Hemipterans, and Coleopterans (Table 6), probably all items that were wind carried from riparian vegetation bordering the collecting sites.

The basic habitat requirements of both smalleye and sharpnose shiners are similar. The most commonly utilized habitat for these species was shallow water moderately flowing over a fairly clean sand bottom (See **Photographs 3 and 4**). Based upon food acquisition habits, the two species appear to partition the water column and available food resources. Habitat (broad open sandy channels swept clean by moderate currents) commonly utilized by the two shiners is abundant in the upper Brazos system but is much more limited downstream of the mainstem impoundments. The loss or conversion of suitable habitat, and a tendency towards more habitat heterogeneity (changes in substrates, changes in water clarity and depths, and changes in flow regimes) can be attributed for the most part to the presence of impoundments constructed in the 1940's and 1950's in the Brazos River. Reservoirs are also primarily responsible for a number of water quality changes. Reductions in turbidity, dissolved oxygen levels, specific conductance, and water temperature fluctuations coupled with smaller fluctuations in streamflow are alterations to the Brazos River ecosystem that have impacted native fish faunas.

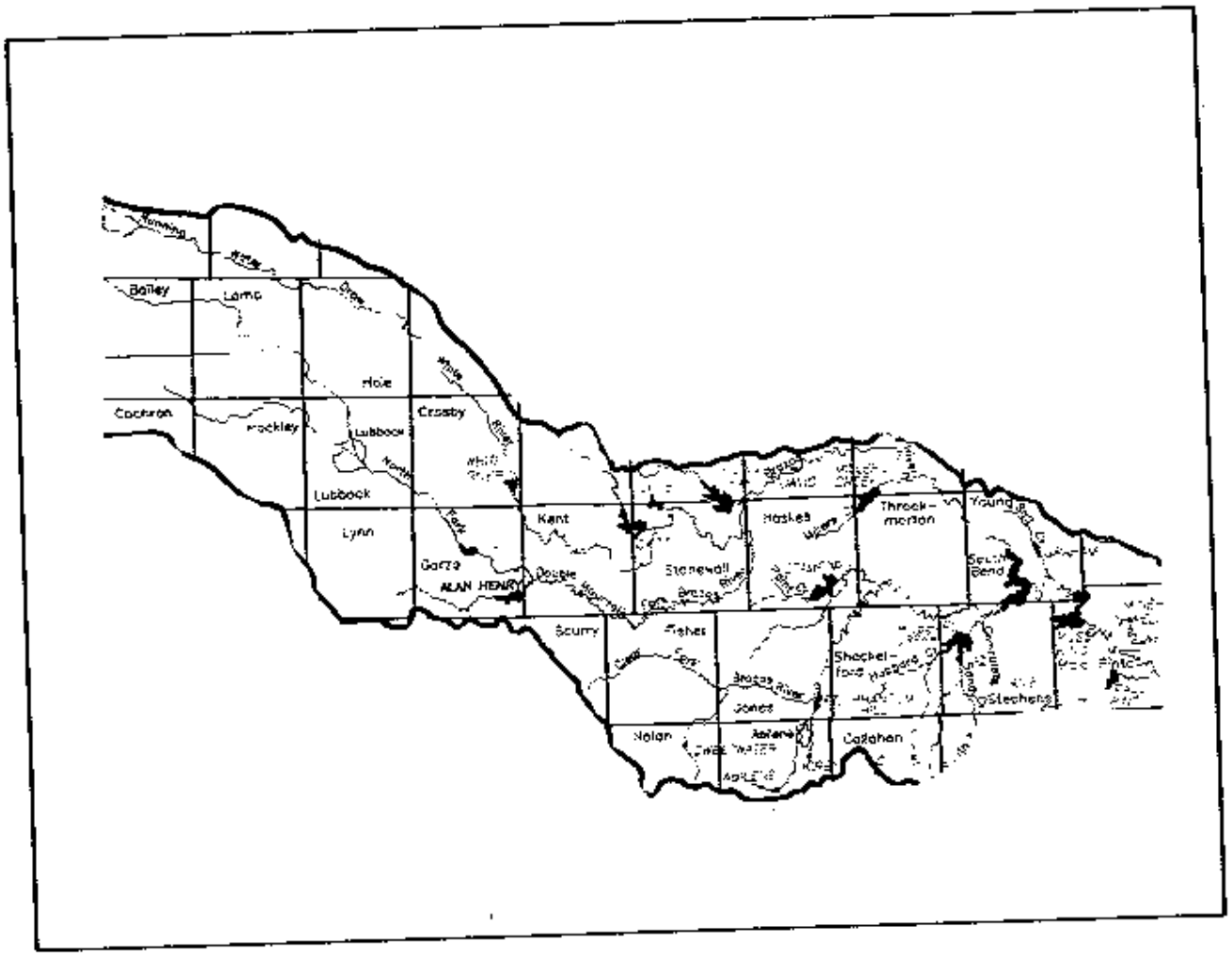
The environmental effects of dams and reservoirs has been reviewed by Baxter (1977) and others (Ward and Stanford, 1979). Baxter restated Thienemann's Rules as: 1) The greater the diversity of conditions in a locality, the larger number of species in the biological community. 2) The more conditions in a locality deviate from the normal, and thus from the optimum for most species, the

smaller the number of species and the greater biomass of each. 3) The longer a locality has been in the same condition, the richer its biological community. Prior to Brazos River mainstem impoundments, Rule 2 was probably a greater influence than Rule 3 in determining the Brazos River aquatic community. After mainstem reservoirs were put in place, Rule 1 soon probably played a greater role than Rule 2. The benthic community was certainly altered (Cloud and Stewart 1984; Coulter 1982). One specific example of the change in the fish fauna is illustrated in the species abundance data from our collections upstream and downstream of Possum Kingdom Reservoir, downstream from which releases are often controlled by peaking operations of a hydroelectric facility (Table 8). The impacts have resulted in a more stable and benign environment in the middle and lower Brazos system less suitable for native prairie cyprinids (i.e. H. placitus, Notropis spp., and Macrhybopsis spp.) and more suitable for some generalist cyprinids such as C. lutrensis (Calhoun 1981; Calhoun et al. 1982; Matthews and Hill, 1977)and Cyprinella venusta, the blacktail shiner (Calhoun 1981; Calhoun et al. 1981), and Pimephales vigilax, the bullhead minnow (Cross and Haslouer 1984). Impoundments on other river systems have resulted in similar changes in native fish faunas in Texas (Edwards 1978) and elsewhere (Spence and Hynes 1971).

Five water development projects (Map 5) are proposed for the upper Brazos drainage (Texas Water Development Board 1990). Alan Henry

Table 3. Species abundances for collections immediately upstream and downstream of Possum Kingdom Reservoir.

Species	Upstream 1	2	3	PK	Downstream 1	2	3
Lepisosteus osseus	1		2				
Dorosoma cepedianum	3	9					6
D. petenense		2	1			2	22
Cyprinella lutrensis	15	7	70		393	510	12
C. venusta					176	3	31
Hybognathus placitus	582	255	103			2	
Macrhybopsis aestivalis	9	11	7				
M. storeriana	2	17	2			1	
Notropis buccula	81	21	4				
N. oxyrhynchus		139	150				
N. potteri	2	6	4				
Pimephales vigilax					65	435	11
Carpiodes carpio	2	2				16	2
Ictalurus punctatus	4	24	1			2	
Gambusia affinis					1	25	1
Labidesthes sicculus					1	18	2
Menidia beryllina	2					42	5
Morone chrysops		2					
Lepomis cyanellus		4	7				
L. humilis			1				
L. macrochirus		1	3		1		
L. megalotis			3		21	1	3
L. microlophus					1		
Micropterus punctulatus					4	2	5
M. salmoides	2	2	4				
Aplodinotus grunniens	1						2
Percina carbonaria						1	



Map 5. Brazos River drainage upstream of Possum Kingdom Reservoir. Alan Henry Reservoir is under construction; Post Reservoir is recommended with municipal conservation savings; South Bend Reservoir is recommended without municipal conservation savings; and , Croton, Dove, and Kiowa Peak Reservoirs are brine-retention reservoirs. Existing reservoirs are blue.

(Source: Texas Water Development Board, December 1990; Plate 1 – Surface Water Development: Existing Reservoirs and Recommended Projects)

Dam near Justiceburg (Garza Co: Double Mountain Fork Brazos R.) is currently under construction. A permitted reservoir, Post Reservoir near Post (Garza Co: North Fork Double Mountain Fork Brazos R.) is proposed to meet the City of Lubbock's water supply needs planning for the year 2040. These two reservoirs will effectively form barriers for fish migration to the upper segments of each of these river forks and cause water quality changes normally associated with reservoirs. Three proposed brine-retention projects (Croton Creek, Dove Creek, and Kiowa Peak) are slated for development, pending funding, to control the amount of brine water entering the Salt Fork Brazos River. Collections of N. buccula were made in Croton Creek (**Appendix I**; Table 34). An additional reservoir, South Bend Reservoir at the confluence of Clear Fork and Salt Fork Brazos R., Young Co., is temporarily not being pursued. If fully implemented, the combined effects of these projects could impact the remaining populations of smalleye and sharpnose shiners. Based on changes from the historical distribution, recent collection information, and the habitat changes that the upper Brazos River system may encounter in the future, it is appropriate that both Notropis buccula and Notropis oxyrhynchus be considered threatened species and that efforts be made to list these species.

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APPENDIX I

TEXAS PARKS AND WILDLIFE DEPARTMENT FIELD COLLECTIONS

Table 1. Texas: Garza Co.: North Fork Double Mountain Fork Brazos River at SH 207 N Post. K. Mayes and J. Glass. 14 May 1992.

Cyprinidae		
Cyprinella lutrensis	Red shiner	10
Hybognathus placitus	Plains minnow	19
Macrhybopsis aestivalis	Speckled chub	2
Notropis buccula	Smalleye shiner	53
Notropis oxyrhynchus	Sharpnose shiner	10
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	6

Table 2. Texas: Garza Co.: North Fork Double Mountain Fork Brazos River at FM 651 NE Post. K. Mayes and J. Glass. 14 May 1992.

Cyprinidae		
Cyprinella lutrensis	Red shiner	23
Hybognathus placitus	Plains minnow	2
Notropis buccula	Smalleye shiner	62
Notropis oxyrhynchus	Sharpnose shiner	129
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	1

Table 3. Texas: Garza Co.: North Fork Double Mountain Fork Brazos River at US 380 E Post. R. Moss, K. Mayes, and K. Saunders. 21 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	64
Hybognathus placitus	Plains minnow	5
Notropis buccula	Smalleye shiner	42
Notropis oxyrhynchus	Sharpnose shiner	26
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	10
Poeciliidae		
Gambusia affinis	Western mosquitofish	15

Table 4. Texas: Garza Co.: Double Mountain Fork Brazos River at SH 84 near Justiceburg. K. Mayes and J. Glass. 14 May 1992.

Cyprinidae		
Cyprinella lutrensis	Red shiner	46
Hybognathus placitus	Plains minnow	45
Notropis buccula	Smalleye shiner	21
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	46
Fundulus zebrinus	Plains killifish	151
Centrarchidae		
Lepomis cyanellus	Green sunfish	1

Table 5. Texas: Kent Co.: Double Mountain Fork Brazos River at SH 208 S Clairemont. R. Moss, E. Marsh, K. Mayes, and S. Jones. 15 August 1989.

Cyprinidae		
Cyprinella lutrensis	Red shiner	205
Hybognathus placitus	Plains minnow	493
Macrhybopsis aestivalis	Speckled chub	9
Notropis buccula	Smalleye shiner	469
Notropis oxyrhynchus	Sharpnose shiner	8
Catostomidae		
Carpiodes carpio	River carpsucker	3
Ictaluridae		
Ameiurus melas	Black bullhead	4
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	1
Fundulus zebrinus	Plains killifish	91
Poeciliidae		
Gambusia affinis	Western mosquitofish	1
Centrarchidae		
Micropterus sp.	Black bass species	1

Table 6. Texas: Fisher Co.: Double Mountain Fork Brazos River at SH 70 N Rotan. R. Moss, K. Mayes, and K. Saunders. 22 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	145
Hybognathus placitus	Plains minnow	180
Macrhybopsis aestivalis	Speckled chub	5
Notropis buccula	Smalleye shiner	211
Notropis oxyrhynchus	Sharpnose shiner	47
Notropis potteri	Chub shiner	1
Catostomidae		
Carpiodes carpio	River carpsucker	1
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	14
Poeciliidae		
Gambusia affinis	Western mosquitofish	2
Atherinidae		
Menidia beryllina	Inland silverside	1

Table 7. Texas: Stonewall Co.: Double Mountain Fork Brazos River at US 83 S Aspermont. R. Moss, E. Marsh, K. Mayes, and S. Jones. 15 August 1989.

Cyprinidae		
Cyprinella lutrensis	Red shiner	93
Hybognathus placitus	Plains minnow	661
Macrhybopsis aestivalis	Speckled chub	4
Notropis buccula	Smalleye shiner	303
Notropis oxyrhynchus	Sharpnose shiner	697
Notropis potteri	Chub shiner	1
Catostomidae		
Carpiodes carpio	River carpsucker	15
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	3
Poeciliidae		
Gambusia affinis	Western mosquitofish	16

Table 8. Texas: Kent Co.: Salt Fork Brazos River at US 380 SW Jayton. R. Moss, R. Kleinsasser, and R. Wahl. 8 October 1988.

Cyprinidae		
Hybognathus placitus	Plains minnow	518
Notropis buccula	Smalleye shiner	69
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	878
Fundulus zebrinus	Plains killifish	112
Poeciliidae		
Gambusia affinis	Western mosquitofish	14

Table 9. Texas: Stonewall Co.: Salt Fork Brazos River at US 83 N Aspermont. R. Moss, R. Kleinsasser, and R. Wahl. 8 October 1988.

Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	291

Table 10. Texas: Stonewall Co.: Salt Fork Brazos River at US 83 N Aspermont. R. Moss, K. Mayes, and K. Saunders. 23 August 1991.

Cyprinidae		
Hybognathus placitus	Plains minnow	49
Notropis buccula	Smalleye shiner	12
Notropis oxyrhynchus	Sharpnose shiner	4
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	213
Fundulus zebrinus	Plains killifish	68

Table 11. Texas: Knox Co.: Salt Fork Brazos River at SH 222 W Knox City. R. Moss, R. Kleinsasser, and R. Wahl. 9 October 1988.

Cyprinidae		
Cyprinella lutrensis	Red shiner	2
Hybognathus placitus	Plains minnow	1405
Macrhybopsis aestivalis	Speckled chub	13
Notropis buccula	Smalleye shiner	96
Notropis oxyrhynchus	Sharpnose shiner	21
Catostomidae		
Carpiodes carpio	River carpsucker	1
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	92
Fundulus zebrinus	Plains killifish	19
Poeciliidae		
Gambusia affinis	Western mosquitofish	5

Table 12. Texas: Knox Co.: Salt Fork Brazos River at SH 222 W Knox City. R. Moss, K. Mayes, and K. Saunders. 23 August 1991.

Cyprinidae		
Hybognathus placitus	Plains minnow	86
Macrhybopsis aestivalis	Speckled chub	5
Notropis buccula	Smalleye shiner	172
Notropis oxyrhynchus	Sharpnose shiner	48
Notropis potteri	Chub shiner	2
Catostomidae		
Carpiodes carpio	River carpsucker	7
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	1
Fundulus zebrinus	Plains killifish	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	3

Table 13. Texas: Knox Co.: Salt Fork Brazos River at FM 267 N Rineland. R. Moss, R. Kleinsasser, and R. Wahl. 9 October 1988.

Cyprinidae		
Cyprinella lutrensis	Red shiner	8
Hybognathus placitus	Plains minnow	588
Macrhybopsis aestivalis	Speckled chub	12
Notropis buccula	Smalleye shiner	91
Notropis oxyrhynchus	Sharpnose shiner	15
Notropis potteri	Chub shiner	2
Catostomidae		
Carpiodes carpio	River carpsucker	2
Ictaluridae		
Ameiurus melas	Black bullhead	1
Ictalurus punctatus	Channel catfish	1
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	3
Fundulus zebrinus	Plains killifish	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	42
Centrarchidae		
Lepomis humilis	Orangespotted sunfish	1

Table 14. Texas: Baylor Co.: Salt Fork Brazos River at US 183/283 Seymour. R. Moss and R. Wahl. 9 October 1988.

Cyprinidae		
Cyprinella lutrensis	Red shiner	1
Hybognathus placitus	Plains minnow	246
Macrhybopsis aestivalis	Speckled chub	1
Notropis buccula	Smalleye shiner	49
Notropis oxyrhynchus	Sharpnose shiner	15
Catostomidae		
Carpiodes carpio	River carpsucker	1
Poeciliidae		
Gambusia affinis	Western mosquitofish	4

Table 15. Texas: Baylor Co.: Salt Fork Brazos River at US 183/283 Seymour. R. Moss and K. Mayes. 16/17 August 1989.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	1
Clupeidae		
Dorosoma cepedianum	Gizzard shad	1
Cyprinidae		
Cyprinella lutrensis	Red shiner	111
Hybognathus placitus	Plains minnow	360
Macrhybopsis aestivalis	Speckled chub	3
Notropis buccula	Smalleye shiner	122
Notropis oxyrhynchus	Sharpnose shiner	598
Notropis potteri	Chub shiner	18
Catostomidae		
Carpiodes carpio	River carpsucker	56
Ictaluridae		
Ictalurus punctatus	Channel catfish	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	14
Centrarchidae		
Lepomis cyanellus	Green sunfish	1
Lepomis humilis	Orangespotted sunfish	5
Lepomis macrochirus	Bluegill	1

Table 16. Texas: Young Co.: Salt Fork Brazos River at SH 79 E Elbert. R. Moss and R. Wahl. 10 October 1988.

Cyprinidae		
Cyprinella lutrensis	Red shiner	44
Cyprinus carpio	Common carp	1
Hybognathus placitus	Plains minnow	559
Macrhybopsis aestivalis	Speckled chub	30
Notropis buccula	Smalleye shiner	38
Notropis oxyrhynchus	Sharpnose shiner	70
Notropis potteri	Chub shiner	3
Pimephales vigilax	Bullhead minnow	2
Ictaluridae		
Ictalurus punctatus	Channel catfish	1
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	8
Centrarchidae		
Lepomis humilis	Orangespotted sunfish	4

Table 17. Texas: Young Co.: Salt Fork Brazos River at SH 79 E Elbert. R. Kleinsasser, G. Linam, and S. Jones. 19 July 1990.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	1
Clupeidae		
Dorosoma cepedianum	Gizzard shad	3
Cyprinidae		
Cyprinella lutrensis	Red shiner	15
Hybognathus placitus	Plains minnow	582
Macrhybopsis aestivalis	Speckled chub	9
Macrhybopsis storeriana	Silver chub	2
Notropis buccula	Smalleye shiner	81
Notropis potteri	Chub shiner	2
Catostomidae		
Carpiodes carpio	River carpsucker	2
Ictaluridae		
Ictalurus punctatus	Channel catfish	4
Atherinidae		
Menidia beryllina	Inland silverside	2
Centrarchidae		
Micropterus salmoides	Largemouth bass	2
Sciaenidae		
Aplodinotus grunniens	Freshwater drum	1

Table 18. Texas: Young Co.: Salt Fork Brazos River at US 380 W Newcastle. R. Kleinsasser, G. Linam, and S. Jones. 19 July 1990.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	9
Dorosoma petenense	Threadfin shad	2
Cyprinidae		
Cyprinella lutrensis	Red shiner	7
Hybognathus placitus	Plains minnow	255
Macrhybopsis aestivalis	Speckled chub	11
Macrhybopsis storeriana	Silver chub	17
Notropis buccula	Smalleye shiner	21
Notropis oxyrhynchus	Sharpnose shiner	139
Notropis potteri	Chub shiner	6
Catostomidae		
Carpiodes carpio	River carpsucker	2
Ictaluridae		
Ictalurus punctatus	Channel catfish	24
Percichthyidae		
Morone chrysops	White bass	2
Centrarchidae		
Lepomis cyanellus	Green sunfish	4
Lepomis macrochirus	Bluegill	1
Micropterus salmoides	Largemouth bass	2

Table 19. Texas: Young Co.: Salt Fork Brazos River at US 380 W Newcastle. R. Moss, K. Mayes, and K. Saunders. 24 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	3
Hybognathus placitus	Plains minnow	585
Macrhybopsis aestivalis	Speckled chub	11
Macrhybopsis storeriana	Silver chub	1
Notropis buccula	Smalleye shiner	467
Notropis oxyrhynchus	Sharpnose shiner	79
Notropis potteri	Chub shiner	11
Pimephales vigilax	Bullhead minnow	4
Catostomidae		
Carpiodes carpio	River carpsucker	2
Ictaluridae		
Ictalurus punctatus	Channel catfish	4
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	1
Centrarchidae		
Lepomis cyanellus	Green sunfish	5

Table 20. Texas: Young Co.: Salt Fork Brazos River at FM 209 S Newcastle. R. Kleinsasser, G. Linam, and S. Jones. 19 July 1990.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	2
Clupeidae		
Dorosoma petenense	Threadfin shad	1
Cyprinidae		
Cyprinella lutrensis	Red shiner	70
Hybognathus placitus	Plains minnow	103
Macrhybopsis aestivalis	Speckled chub	7
Macrhybopsis storeriana	Silver chub	2
Notropis buccula	Smalleye shiner	4
Notropis oxyrhynchus	Sharpnose shiner	150
Notropis potteri	Chub shiner	4
Ictaluridae		
Ictalurus punctatus	Channel catfish	1
Centrarchidae		
Lepomis cyanellus	Green sunfish	7
Lepomis humilis	Orangespotted sunfish	1
Lepomis macrochirus	Bluegill	3
Lepomis megalotis	Longear sunfish	3
Micropterus salmoides	Largemouth bass	4

Table 21. Texas: Shackelford Co.: Clear Fork Brazos River at SH 6 near Leaders. R. Moss, E. Marsh, K. Mayes, S. Jones. 16 August 1989.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	29
Cyprinidae		
Cyprinella lutrensis	Red shiner	7
Poeciliidae		
Gambusia affinis	Western mosquitofish	1
Centrarchidae		
Lepomis cyanellus	Green sunfish	1
Lepomis humilis	Orangespotted sunfish	11
Lepomis macrochirus	Bluegill	4
Pomoxis nigromaculatus	Black crappie	1

Table 22. Texas: Fisher Co.: Clear Fork Brazos River at US 180 E Roby. R. Moss, E. Marsh, K. Mayes, and S. Jones. 16 August 1989.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	6
Cyprinidae		
Cyprinella lutrensis	Red shiner	876
Ictaluridae		
Ameiurus melas	Black bullhead	1
Ictalurus punctatus	Channel catfish	1
Poeciliidae		
Gambusia affinis	Western mosquitofish	2067
Centrarchidae		
Lepomis cyanellus	Green sunfish	1
Lepomis humilis	Orangespotted sunfish	3
Lepomis megalotis	Longear sunfish	18

Table 23. Texas: Palo Pinto Co.: Brazos River at US 180 W Mineral Wells. R. Moss and K. Mayes. 17 August 1989.

Cyprinidae		
Cyprinella lutrensis	Red shiner	393
Cyprinella venusta	Blacktail shiner	176
Pimephales vigilax	Bullhead minnow	65
Poeciliidae		
Gambusia affinis	Western mosquitofish	1
Atherinidae		
Labidesthes sicculus	Brook silverside	1
Centrarchidae		
Lepomis macrochirus	Bluegill	1
Lepomis megalotis	Longear sunfish	21
Lepomis microlophus	Redear sunfish	1
Micropterus punctulatus	Spotted bass	4

Table 24. Texas: Palo Pinto Co.: Brazos River at US 281 S Mineral Wells. R. Moss and R. Wahl. 10 October 1988.

Clupeidae		
Dorosoma petenense	Threadfin shad	2
Cyprinidae		
Cyprinella lutrensis	Red shiner	510
Cyprinella venusta	Blacktail shiner	3
Hybognathus placitus	Plains minnow	2
Macrhybopsis storeriana	Silver chub	1
Pimephales vigilax	Bullhead minnow	435
Catostomidae		
Carpiodes carpio	River carpsucker	16
Ictaluridae		
Ictalurus punctatus	Channel catfish	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	25
Atherinidae		
Labidesthes sicculus	Brook silverside	18
Menidia beryllina	Inland silverside	42
Centrarchidae		
Lepomis megalotis	Longear sunfish	1
Micropterus punctulatus	Spotted bass	2
Percidae		
Percina carbonaria	Texas logperch	1

Table 25. Texas: Parker Co.: Brazos River at IH 20 feeder road W Brock. R. Moss, K. Mayes, and K. Saunders. 24 August 1991.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	6
Dorosoma petenense	Threadfin shad	22
Cyprinidae		
Cyprinella lutrensis	Red shiner	12
Cyprinella venusta	Blacktail shiner	31
Pimephales vigilax	Bullhead minnow	11
Catostomidae		
Carpiodes carpio	River carpsucker	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	1
Atherinidae		
Labidesthes sicculus	Brook silverside	2
Menidia beryllina	Inland silverside	5
Centrarchidae		
Lepomis megalotis	Longear sunfish	3
Micropterus punctulatus	Spotted bass	5
Sciaenidae		
Aplodinotus grunniens	Freshwater drum	2

Table 26. Texas: Falls Co.: Brazos River at SH 7 W Marion. R. Moss and K. Mayes. 18 August 1989.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	82
Cyprinidae		
Cyprinella lutrensis	Red shiner	71
Cyprinella venusta	Blacktail shiner	10
Pimephales vigilax	Bullhead minnow	1
Ictaluridae		
Ictalurus punctatus	Channel catfish	24
Atherinidae		
Labidesthes sicculus	Brook silverside	5
Menidia beryllina	Inland silverside	1
Centrarchidae		
Lepomis cyanellus	Green sunfish	1
Lepomis humilis	Orangespotted sunfish	9
Lepomis macrochirus	Bluegill	1
Lepomis megalotis	Longear sunfish	28
Micropterus punctulatus	Spotted bass	2
Pomoxis annularis	White crappie	11
Sciaenidae		
Aplodinotus grunniens	Freshwater drum	1

Table 27. Texas: Milam Co.: Brazos River at FM 485 W Hearne. K. Mayes and K. Saunders. 10 July 1991.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	1
Dorosoma petenense	Threadfin shad	5
Cyprinidae		
Cyprinella lutrensis	Red shiner	116
Notemigonus crysoleucas	Golden shiner	1
Notropis buchanani	Ghost shiner	6
Notropis oxyrhynchus	Sharpnose shiner	1
Notropis potteri	Chub shiner	6
Notropis shumardi	Silverband shiner	8
Pimephales vigilax	Bullhead minnow	21
Ictaluridae		
Ictalurus punctatus	Channel catfish	1
Poeciliidae		
Gambusia affinis	Western mosquitofish	3
Atherinidae		
Menidia beryllina	Inland silverside	2
Centrarchidae		
Pomoxis annularis	White crappie	1

Table 28. Texas: Brazos Co.: Brazos River 1.5 mi upstream of "Mussel Shoals" near FM 1688 W College Station. R. Moss, K. Mayes, and K. Saunders. 1 August 1991.

Lepisosteidae		
Lepisosteus oculatus	Spotted gar	1
Clupeidae		
Dorosoma cepedianum	Gizzard shad	1
Dorosoma petenense	Threadfin shad	1
Cyprinidae		
Cyprinella lutrensis	Red shiner	57
Hybognathus nuchalis	Mississippi silvery minnow	1
Notemigonus crysoleucas	Golden shiner	1
Notropis buchanani	Ghost shiner	1
Notropis oxyrhynchus	Sharpnose shiner	1
Notropis potteri	Chub shiner	3
Pimephales vigilax	Bullhead minnow	3
Catostomidae		
Carpiodes carpio	River carpsucker	96
Ictaluridae		
Ictalurus punctatus	Channel catfish	17
Poeciliidae		
Gambusia affinis	Western mosquitofish	20
Centrarchidae		
Lepomis cyanellus	Green sunfish	1
Lepomis megalotis	Longear sunfish	1
Micropterus salmoides	Largemouth bass	1

Table 29. Texas: Brazos Co.: Brazos River at "Mussel Shoals" at end of FM 1688 W College Station. R. Moss, K. Mayes, and K. Saunders. 1 August 1991.

Lepisosteidae		
Lepisosteus oculatus	Spotted gar	3
Clupeidae		
Dorosoma cepedianum	Gizzard shad	8
Cyprinidae		
Cyprinella lutrensis	Red shiner	60
Notropis buchanani	Ghost shiner	4
Notropis oxyrhynchus	Sharpnose shiner	3
Notropis potteri	Chub shiner	3
Notropis shumardi	Silverband shiner	14
Pimephales vigilax	Bullhead minnow	13
Catostomidae		
Carpiodes carpio	River carpsucker	173
Ictaluridae		
Ictalurus punctatus	Channel catfish	4
Noturus gyrinus	Tadpole madtom	1
Poeciliidae		
Gambusia affinis	Western mosquitofish	2

Table 30. Texas: Brazos Co.: Brazos River at Hidalgo Falls off FM 159 W Navasota. R. Moss, K. Mayes, and K. Saunders. 3 July 1991.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	8
Dorosoma petenense	Threadfin shad	105
Cyprinidae		
Cyprinella lutrensis	Red shiner	241
Hybognathus nuchalis	Mississippi silvery minnow	26
Macrhybopsis storeriana	Silver chub	1
Notropis buchanani	Ghost shiner	67
Notropis oxyrhynchus	Sharpnose shiner	10
Notropis potteri	Chub shiner	1
Notropis shumardi	Silverband shiner	169
Opsopoeodus emiliae	Pugnose minnow	3
Pimephales vigilax	Bullhead minnow	7
Poeciliidae		
Gambusia affinis	Western mosquitofish	3
Atherinidae		
Menidia beryllina	Inland silverside	1
Centrarchidae		
Lepomis sp.	Juvenile sunfish	2

Table 31. Texas: Washington Co.: Brazos River at SH 105 SW Navasota. R. Moss, K. Mayes, and K. Saunders. 4 July 1991.

Clupeidae		
Dorosoma cepedianum	Gizzard shad	2
Dorosoma petenense	Threadfin shad	10
Cyprinidae		
Cyprinella lutrensis	Red shiner	101
Hybognathus nuchalis	Mississippi silvery minnow	6
Macrhybopsis aestivalis	Speckled chub	4
Notropis buchanani	Ghost shiner	10
Notropis potteri	Chub shiner	5
Notropis shumardi	Silverband shiner	61
Pimephales vigilax	Bullhead minnow	16
Poeciliidae		
Gambusia affinis	Western mosquitofish	1
Centrarchidae		
Lepomis macrochirus	Bluegill	1

Table 32. Texas: Austin Co.: Brazos River at Racoon Bend oil field road off FM 331 S Hempstead. K. Mayes and K. Saunders. 24 July 1991.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	1
Clupeidae		
Dorosoma cepedianum	Gizzard shad	1
Cyprinidae		
Cyprinella lutrensis	Red shiner	57
Hybognathus nuchalis	Mississippi silvery minnow	3
Macrhybopsis aestivalis	Speckled chub	1
Notropis buchanani	Ghost shiner	2
Notropis oxyrhynchus	Sharpnose shiner	5
Notropis potteri	Chub shiner	70
Notropis shumardi	Silverband shiner	14
Pimephales promelas	Fathead minnow	1
Pimephales vigilax	Bullhead minnow	117
Catostomidae		
Carpiodes carpio	River carpsucker	70
Ictiobus bubalus	Smallmouth buffalo	1
Ictaluridae		
Ictalurus furcatus	Blue catfish	1
Ictalurus punctatus	Channel catfish	9
Pylodictis olivaris	Flathead catfish	3
Poeciliidae		
Gambusia affinis	Western mosquitofish	4
Centrarchidae		
Lepomis macrochirus	Bluegill	1
Micropterus salmoides	Largemouth bass	2
Mugilidae		
Mugil cephalus	Striped mullet	1

Table 33. Texas: Fort Bend Co.: Brazos River at FM 1093 E Simonton. K. Mayes and K. Saunders. 23 July 1991.

Clupeidae		
Dorosoma petenense	Threadfin shad	3
Cyprinidae		
Cyprinella lutrensis	Red shiner	75
Macrhybopsis aestivalis	Speckled chub	1
Macrhybopsis storeriana	Silver chub	9
Notropis buchanani	Ghost shiner	2
Notropis oxyrhynchus	Sharpnose shiner	7
Notropis potteri	Chub shiner	56
Notropis shumardi	Silverband shiner	3
Pimephales vigilax	Bullhead minnow	33
Catostomidae		
Carpiodes carpio	River carpsucker	30
Ictaluridae		
Ictalurus punctatus	Channel catfish	11
Aphredoderidae		
Aphredoderus sayanus	Pirate perch	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	3
Centrarchidae		
Lepomis cyanellus	Green sunfish	8
Lepomis macrochirus	Bluegill	1
Lepomis megalotis	Longear sunfish	1
Cichlidae		
Tilapia aurea	Blue tilapia	1

Table 34. Texas: Kent Co.: Croton Creek at County Road N Jayton. G. Linam and J. Glass. 15 August 1989.

Cyprinidae		
Hybognathus placitus	Plains minnow	25
Notropis buccula	Smalleye shiner	5
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	1954
Fundulus zebrinus	Plains killifish	482

Table 35. Texas: Stephens Co.: Sandy Creek at FM 576 E Eolian. R. Moss, E. Marsh, K. Mayes, and S. Jones. 16 August 1989.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	2
Clupeidae		
Dorosoma cepedianum	Gizzard shad	8
Cyprinidae		
Cyprinella lutrensis	Red shiner	68
Notemigonus crysoleucas	Golden shiner	1
Pimephales vigilax	Bullhead minnow	43
Ictaluridae		
Ictalurus punctatus	Channel catfish	1
Cyprinodontidae		
Fundulus notatus	Blackstripe topminnow	2
Poeciliidae		
Gambusia affinis	Western mosquitofish	304
Atherinidae		
Menidia beryllina	Inland silverside	20
Centrarchidae		
Lepomis cyanellus	Green sunfish	4
Lepomis humilis	Orangespotted sunfish	1
Lepomis megalotis	Longear sunfish	78
Micropterus salmoides	Largemouth bass	1
Pomoxis annularis	White crappie	3
Percidae		
Percina macrolepida	Bigscale logperch	1

Table 36. Texas: Bell Co.: Lampasas River at Elm Grove Rd S Temple. K. Mayes and K. Saunders. 9 July 1991.

Cyprinidae		
Cyprinella venusta	Blacktail shiner	14
Notropis volucellus	Mimic shiner	4
Percidae		
Etheostoma spectabile	Orangethroat darter	2

Table 38. Texas: Knox Co.: North Wichita River at FM 267 N Gilliland. R. Moss, K. Mayes, and K. Saunders. 23 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	400
Macrhybopsis aestivalis	Speckled chub	10
Notropis bairdi	Red River shiner	5
Pimephales promelas	Fathead minnow	2
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	1
Fundulus zebrinus	Plains killifish	29

Table 39. Texas: Knox Co.: South Wichita River at SH 6 N Benjamin. R. Moss, K. Mayes, and K. Saunders. 23 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	141
Hybognathus placitus	Plains minnow	4
Macrhybopsis aestivalis	Speckled chub	1
Notropis bairdi	Red River shiner	1
Pimephales promelas	Fathead minnow	1
Cyprinodontidae		
Fundulus zebrinus	Plains killifish	7

Table 40. Texas: Baylor Co.: Wichita River at FM 1919 NW Seymour. R. Moss, K. Mayes, and K. Saunders. 23 August 1991.

Cyprinidae		
Cyprinella lutrensis	Red shiner	327
Hybognathus placitus	Plains minnow	5
Macrhybopsis aestivalis	Speckled chub	21
Notropis bairdi	Red River shiner	11
Pimephales vigilax	Bullhead minnow	2
Ictaluridae		
Ictalurus punctatus	Channel catfish	1
Cyprinodontidae		
Cyprinodon rubrofluviatilis	Red River pupfish	1
Fundulus zebrinus	Plains killifish	3
Centrarchidae		
Lepomis cyanellus	Green sunfish	2

Table 41. Texas: Wichita Co.: Wichita River at FM 368 W Wichita Falls. R. Moss, K. Mayes, and K. Saunders. 24 August 1991.

Lepisosteidae		
Lepisosteus osseus	Longnose gar	2
Cyprinidae		
Cyprinella lutrensis	Red shiner	190
Hybognathus placitus	Plains minnow	1
Pimephales vigilax	Bullhead minnow	2
Catostomidae		
Ictiobus niger	Black buffalo	1
Poeciliidae		
Gambusia affinis	Western mosquitofish	4
Centrarchidae		
Lepomis humilis	Orangespotted sunfish	4

APPENDIX II

UNIVERSITY MUSEUM AND FISH COLLECTION RECORDS

ILLINOIS NATURAL HISTORY SURVEY FISH COLLECTION (INHC)

Texas: Knox Co: Salt Fork of the Brazos River, 2 mile north of Rhineland, at crossing of FM 267. L.T. Knapp and class. TCWC M-3-D-360.

Notropis bairdi	6 = N. buccula	INHC 83346

Texas: Kent Co: Salt Fork of the Brazos River 6 miles SW of Jayton. Knapp and class. 14 October 1951. TAMU(TCWC) 1094.

Notropis bairdi	2 = N. buccula	INHC 88490

Texas: Baylor Co: U.S. highway 277 crossing of Brazos River at Seymour. M. Retzer, L. Page, Cummings, and Swanson. 28 July 1984. TAMU(TCWC) 3908.4

Notropis buccula	1	INHC 67801

UNIVERSITY OF KANSAS
MUSEUM OF NATURAL HISTORY

Field notes of Dr. Frank B. Cross
Information provided by Joseph T. Collins

Texas: Palo Pinto Co: Brazos River on Hiway 281, approx. 7 miles south of Mineral Wells. G.A. Moore and F.B. Cross. 14 April 1952. (C-39-52).

Cyprinidae		
Hybopsis aestivalis aestivalis	2	
Notropis bairdi	16	=N. b. buccula types (paratypes) KU 2318
Notropis buchanani	4	
Notropis brazosensis	3	=N. shumardi
Notropis lutrensis	5	=C. lutrensis
Notropis oxyrhynchus	32	
Notropis potteri	8	
Notropis venustus	9	
Notropis volucellus nocomis	10	
Notropis (lutrensis X venustus)	6	
Pimephales vigilax vigilax	12	
Catostomidae		
Carpiodes carpio microstomus	1	
Ictaluridae		
Ictalurus sp.		
Centrarchidae		
Micropterus punctulatus		
Lepomis cyanellus	15	
Lepomis macrochirus	16	
Lepomis megalotis breviceps	17	
Percidae		
Etheostoma spectabile	13	
Hadropterus scierus	14	
Sciaenidae		
Aplodinotus grunniens		

Texas: Palo Pinto Co: Brazos River, 11 miles south of Mineral Wells. G.A. Moore and F.B. Cross. 14 April 1952.

Cyprinidae		
Notropis bairdi	1	= N. buccula KU 2642

Texas: Wichita Co: upper end of Lake Wichita. L. Lewis, W.W. Dalquest, and F.B. Cross. 26 September 1953.

Cyprinidae
Notemigonus crysoleucas
Notropis l. lutrensis
Notropis buchanani
Pimephales promelas confertus
Pimephales vigilax vigilax

Ictaluridae
Ameiurus melas catulus

Poeciliidae
Gambusia affinis affinis

Centrarchidae
Chaenobryttus coronarius
Lepomis cyanellus
Lepomis humilis
Lepomis macrochirus
Lepomis megalotis

Percidae
Percina caprodes

Texas: Wichita Co: Wichita River below Diversion Dam. Seven miles West of Kamay. F.B. Cross, L. Lewis, and W.W. Dalquest. 27 September 1953.

Cyprinidae
Notropis l. lutrensis

Poecillidae
Gambusia affinis

Centrarchidae
Lepomis megalotis

Texas: Knox Co: South Fork Wichita River 5 miles North of Benjamin on #283. F.B. Cross, W.W. Dalquest, and L. Lewis. 27 September 1953. (C-113-53).

Cyprinidae

Hybopsis aestivalia australis	2	
Hybognathus placita		
Notropis b. bairdi	94	KU 3072
Notropis oxyrhynchus	8	KU 3073

Cyprinodontidae
Cyprinodon rubrofluviatilis
Fundulus kansae = F. zebrinus

Texas: Knox Co: Brazos River 5 miles south of Benjamin. F.B. Cross, W.W. Dalquest, and L. Lewis. 27 September 1953. (C-115-53).

Cyprinidae		
Hybognathus placita amara		
Notropis bairdi buccula	71	KU 3077
Notropis lutrensis		
Notropis oxyrhynchus	236	KU 3073
Notropis potteri		
Ictaluridae		
Ameiurus melas		
Poecillidae		
Gambusia a. affinis		

Texas: Foard Co: North Fork Wichita River, 10 miles west of Crowell. 4 January 1955.

Cyprinidae	
Notropis oxyrhynchus	1

Texas: Brazos Co: Brazos River near Bryan. F.B. Cross, A. Bjelland, L. Cavin, and J. Laswell. 25 April 1970. (FBC-14-1970)

Cyprinidae		
Hybopsis aestivalis	19	KU 14285
Notropis oxyrhynchus	9	KU 14288
Notropis potteri	49	KU 14289
Notropis lutrensis	37	KU 14287
Notropis shumardi	33	KU 14290
Notropis buccula	20	KU 14286
Pimephales vigilax	43	KU 14291
Catostomidae		
Carpiodes carpio	23	KU 14284

Ictaluridae		
Ictalurus punctatus	9	KU 14292
Poecillidae		
Gambusia affinis	1	

Texas A&M University (TAMU)
Texas Cooperative Wildlife Collection (TCWC)

Texas: Baylor Co: Brazos River at Seymour at Station 41. F.T. Knapp and class. 13 October 1951. TAMU(TCWC) 0159.

TAMU(TCWC) 0159

.1	Dorosoma cepedianum	2	specimens
.2	Notropis oxyrhynchus	137	"
.3	Notropis potteri	43	"

Texas: Baylor Co: Brazos River 10 miles south of Seymour at Station 40. J.T. Knapp and class. 14 October 1951. TAMU(TCWC) 0160.

TAMU(TCWC) 0160

.1	Dorosoma cepedianum	21	specimens
.2	Pimephales vigilax	3	"
.3	Lepomis megalotis	36	"
.4	Micropterus salmoides	4	"
.5	Pomoxis annularis	28	"

Texas: Waller Co: Brazos River 8 miles east of Sealy. J.T. Knapp and class. 15 October 1951. TAMU(TCWC) 0161.

TAMU(TCWC) 0161.

.1	Pimephales vigilax	5	specimens

Texas: Bell Co: Lampassas River south of Belton at Station 14. J.T. Knapp and class. 13 October 1951. TAMU(TCWC) 0164.

TAMU(TCWC) 0164

.1	Notropis bairdi	5	specimens = N. buccula
.2	Lepomis megalotis	89	"
.3	Micropterus punctulatus	9	"
.4	Micropterus salmoides	1	"

Texas: Bosque Co: Brazos River 200 yards below Whitney Dam at Station 22. J.T. Knapp and class. 14 October 1951. TAMU(TCWC) 0177.

TAMU(TCWC) 0177

.1	Notropis oxyrhynchus	43	specimens	
.2	Notropis lutrensis	143	"	= C. lutrensis
.3	Percina sciera	2	"	

Texas: Brazos/Burleson Cos: Brazos River east of Mussel Shoals, 8 miles west of Bryan, end of FM 1688. Conner, Holcomb, and Koen. 18 February 1967. TAMU(TCWC) 0345.

TAMU(TCWC) 0345

.1	Hybopsis storeriana	5	specimens = M. storeriana

Texas: Brazos/Burleson Cos: Brazos River east of Mussel Shoals, 8 miles west of Bryan (end of FM 1688). Connor and 410 class. 11 March 1967. TAMU(TCWC) 0346

TAMU(TCWC) 0346

.1	Hybopsis storeriana	5	specimens	= M. storeriana
.2	Notropis oxyrhynchus	5	"	
.3	Notropis potteri	19	"	
.4	Notropis shumardi	42	"	
.5	Ictalurus punctatus	50	"	

Texas: Brazos Co: Brazos River at Mussel Shoals, 6 miles east of College Station, 30 36′ X 96 27′. 6 February 1976. TAMU(TCWC) 0938.

TAMU(TCWC) 0938

.1	Hybopsis aestivalis	8	specimens	= M. aestivalis
.2	Notropis buchanani	1	"	= N. potteri
.3	Notropis oxyrhynchus	20	"	
.4	Notropis potteri	70	"	
.5	Notropis shumardi	26	"	
	Notropis buccula	3	"	

Texas: Ft. Bend Co: Brazos River at Hiway 90A at Richmond. F.T. Knapp and class. 15 October 1951. TAMU(TCWC) 0967.

TAMU(TCWC) 0967

.1	Dorosoma cepedianum	10	specimens
.2	Notropis oxyrhynchus	387	"
.3	Carpiodes carpio	9	"

Texas: Kent Co: Salt Fort of the Brazos River 6 miles SW of Jayton. Knapp and class. 14 October 1951. TAMU(TCWC) 1094.

TAMU(TCWC) 1094

.1	Hybognathus placitus	29	specimens
.2	Notropis bairdi	5	" = N. buccula
.3	Notropis oxyrhynchus	5	"
.4	Notropis potteri	2	"
.5	Fundulus kansae	29	" = F. zebrinus

Texas: Fisher Co: Double Mountain Fork of Brazos, 4 miles north of Roton. 14 October 1951. TAMU(TCWC) 1095.

TAMU(TCWC) 1095

.1	Hybognathus placitus	381	specimens
.2	Notropis oxyrhynchus	165	"

Texas: Brazos Co: Brazos River at Welborn Crossing. Bonham and class. 25 October 1940. TAMU(TCWC) 1096.

TAMU(TCWC) 1096

.1	Hybognathus placitus	41	specimens
.2	Hybopsis aestivalis	2	"

Texas: Brazos Co: Brazos River at Government Crossing near Navasota. K. Bonham. 3 December 1939. TAMU(TCWC) 1098.

TAMU(TCWC) 1098

.1	Hybognathus placitus	63	specimens

Texas: Brazos Co: Brazos River 1.8 mile south on Hwy 21 on Leon Cash Ranch. J.M. Davis. 7 November 1964. TAMU(TCWC) 1106.

TAMU(TCWC) 1106

.1	Hybopsis aestivalis	25	specimens
.2	Notropis potteri	42	"
.3	Notropis oxyrhynchus	242	"

Texas: Somerville Co: Brazos River 5 miles east of Glen Rose. Knapp and class. 15 October 1951. TAMU(TCWC) 1109.

TAMU(TCWC) 1109

.1	Hybopsis aestivalis	49	specimens = M. aestivalis
.2	Notropis oxyrhynchus	6	"
.3	Notropis potteri	2	"

Texas: Brazos/Burleson Cos: Brazos River. 311 class. 21 February 1977. TAMU(TCWC) 1171.

TAMU(TCWC) 1171

.1	Notropis shumardi	26	specimens
.2	Notropis oxyrhynchus	227	"
.3	Carpiodes carpio	6	"
.4	Ictiobus bubalus	1	"
.5	Ictalurus punctatus	340	"

Texas: Brazos/Burleson Cos: Brazos River. J.V. Conner. 26 October 1965. TAMU(TCWC) 1216.

TAMU(TCWC) 1216

.1	Notropis potteri	5	specimens
.2	Carpiodes carpio	8	"
.3	Ictalurus punctatus	38	"
.4	Pomoxis annularis	7	"
	Notropis buccula	1	"

Texas: Brazos/Burleson Cos: Brazos River. 311 class. 30 October 1965. TAMU(TCWC) 1217.

TAMU(TCWC) 1217

.1	Notropis potteri	5	specimens
	Notropis buccula	1	"

Texas: Brazos Co: Brazos River 5 miles west of College Station. K. Bonham and G. E. Spofford. TAMU(TCWC) 1220.

TAMU(TCWC) 1220

.1	Notropis potteri	22	specimens
.2	Notropis buccula	9	"
.3	Cyprinella lutrensis	1	"

Texas: Brazos/Burleson Cos: Brazos River. 311 class. 17 October 1965. TAMU(TCWC) 1257.

TAMU(TCWC) 1257

.1	Notropis oxyrhynchus	146	specimens
.2	Notropis potteri	13	"
.3	Ictalurus punctatus	40	"

Texas: Brazos/Grimes Cos: Brazos River. J.V. Conner. 21 March 1977. TAMU(TCWC) 1260.

TAMU(TCWC) 1260

.1	Carpiodes carpio	1	specimens
.2	Ictalurus punctatus	17	"
.3	Lepomis punctatus	5	"
.4	Pomoxis annularis	11	"
.5	Aplodinotus grunniens	16	"
.6	Etheostoma gracile	1	"

Texas: Robertson Co: Brazos River 5 miles west of Hearne. Page, Retzer, Swanson, Cummings. 25 July 1984. TAMU(TCWC) 3906.

TAMU(TCWC) 3906

.1	Notropis oxyrhynchus	3	specimens

Texas: Baylor Co: Brazos River on Route 277 near Seymour. Retzer, Page, Cummings, Swanson. 28 July 1984. TAMU(TCWC) 3908.

TAMU(TCWC) 3908

.1	Gambusia affinis	5	specimens
.2	Notropis oxyrhynchus	11	"
.3	Cyprinodon rubrofluviatilis	5	"
.4	Notropis buccula	2	"
.5	Fundulus zebrinus	1	"

Many specimens were incorrectly identified and catalogued into the Texas Natural History Collection (Memorial Museum) at the University of Texas at Austin (UT-TNHC). Corrections have been made for many specimens and have been incorporated for this list, however there is additional work necessary to completely resolve every identification for each species.

Texas: Kent Co: Double Mountain Fork of the Brazos River at Hwy 208. R. Wahl, A. Price, and R. Murphy. 28 July 1986. Seines. (4-1)

Cyprinidae		
Hybognathus placitus	61	
Hybopsis aestivalis	1	= M. aestivalis
Notropis lutrensis	101	= C. lutrensis
Notropis oxyrhynchus	7	UT-TNHC 12129
Notropis buccula	12	UT-TNHC 12133
Notropis potteri	1	UT-TNHC 12128
Ictaluridae		
Ictalurus punctatus	2	
Cyprinodontidae		
Fundulus zebrinus	24	
Poeciliidae		
Gambusia affinis	2	

Texas: Kent Co: Salt Fork Brazos River at Hwy 208. R. Wahl, A. Price, and R. Murphy. 28 July 1986. Seines.

Cyprinidae		
Notropis buccula	1	UT-TNHC 12239
Cyprinodontidae		
Cyprinodon rubrofulviatilis	83	
Fundulus zebrinus	49	
Poeciliidae		
Gambusia affinis	22	

Texas: Crosby Co: White River at FM 261. R. Wahl, A. Price, R. Murphy. 29 July 1986. Seines.

Poeciliidae	
Gambusia affinis	13 + fry

Texas: Garza Co: North Fork of the Double Mountain Fork of Brazos River at FM 651. R. Wahl, A. Price, and R. Murphy. 29 July 1986. Seines.

Cyprinidae		
Notropis lutrensis	52	
Notropis buccula	74	UT-TNHC 12249
Cyprinodontidae		
Fundulus zebrinus	78	
Poeciliidae		
Gambusia affinis	1	

Texas: Stonewall Co: Salt Fork Brazos River at U.S. Hwy 380. R. Wahl, A. Price, and R. Murphy. 29 July 1986. Seines.

Cyprinidae		
Hybognathus placitus	6	
Notropis buccula	63	UT-TNHC 12179
Notropis buccula	7	UT-TNHC 12195
Cyprinodontidae		
Cyprinodon rubrofluviatilis	12	
Fundulus zebrinus	5	
Poeciliidae		
Gambusia affinis	2	

Texas: Fisher Co: Double Mountain Fork Brazos River at State Hwy 70. R. Wahl, A. Price, and R. Murphy. 29 July 1986. Seines.

Clupeidae		
Dorosoma cepedianum	4	
Cyprinidae		
Hybognathus placitus	169	
Notropis lutrensis	131	
Notropis oxyrhynchus	3	UT-TNHC 12186
Notropis buccula	46	UT-TNHC 12183
Cyprinodontidae		
Fundulus zebrinus	11	
Poeciliidae		
Gambusia affinis	38 + 1	
Centrarchidae		
Lepomis macrochirus	1	

Texas: Fisher Co: Clear Fork of the Brazos River at U.S. Hwy 180. R. Wahl, A. Price, and R. Murphy. 30 July 1986. Seines.

Cyprinidae	
Notropis lutrensis	42
Ictaluridae	
Ictalurus punctatus	1
Poeciliidae	
Gambusia affinis	7

Texas: Jones Co: Clear Fork of the Brazos River at FM 126. R. Wahl, A. Price, and R. Murphy. 30 July 1986. Seines.

Cyprinidae	
Notropis lutrensis	many
Pimephales vigilax	1
Ictaluridae	
Ictalurus punctatus	1
Poeciliidae	
Gambusia affinis	14

Texas: Jones Co: Clear Fork of the Brazos River at U.S. Hwy 83/277. R. Wahl, A. Price, and R. Murphy. 30 July 1986. Seines.

Cyprinidae	
Hybognathus placitus	1
Notropis lutrensis	many
Poeciliidae	
Gambusia affinis	14

Texas: Jones Co: Clear Fork of the Brazos River at FM 600. R. Wahl, A. Price, and R. Murphy. 30 July 1986.

Clupeidae		
Dorosoma petenense	1	
Cyprinidae		
Notropis lutrensis	47	
Pimephales vigilax	12	
Centrarchidae		
Lepomis megalotis	1	
Poeciliidae		
Gambusia affinis	3	

Texas: Haskell Co: Double Mountain Fork of the Brazos River at U.S. Hwy 380. R. Wahl, A. Price, and R. Murphy. 30 July 1986. Seines.

Cyprinidae		
Hybognathus placitus	25	
Hybopsis aestivalis	15	
Notropis lutrensis	105	
Notropis oxyrhynchus	2	UT-TNHC 12210
Notropis buccula	101	UT-TNHC 12211
Centrarchidae		
Lepomis cyanellus	2	
Cyprinodontidae		
Fundulus zebrinus	1	
Poeciliidae		
Gambusia affinis	11	

Texas: Stonewall Co: Double Mountain Fork of the Brazos River at State Hwy 283. R. Wahl, A. Price, and R. Murphy. 30 July 1986.

Cyprinidae		
Hybognathus placitus	286 + 1	
Hybopsis aestivalis	14	
Notropis lutrensis	34 + 8	
Notropis buccula	157	UT-TNHC 12245
Pimephales promelas	5	
Catostomidae		
Carpiodes carpio	1	
Ictaluridae		
Ictalurus punctatus	1	
Pylodictis olivaris	1	
Poeciliidae		
Gambusia affinis	12	

Texas: Knox Co: Brazos River at State Hwy 222. R. Wahl, A. Price, and R. Murphy. 31 July 1986. Seines.

Cyprinidae		
Hybognathus placitus	83 + 1	
Hybopsis aestivalis	10	
Notropis lutrensis	14 + 1	
Notropis oxyrhynchus	22 + 1	UT-TNHC 12153
Notropis buccula	18	UT-TNHC 12150
Notropis buccula	45	UT-TNHC 12151
Ictaluridae		
Ictalurus punctatus	2	
Cyprinodontidae		
Cyprinodon rubrofluviatilis	4	
Fundulus zebrinus	8	
Poeciliidae		
Gambusia affinis	7	

Texas: Knox Co: Brazos River at State Hwy 6. R. Murphy, A. Price, and R. Wahl. 31 July 1986.

Cyprinidae		
Hybognathus placitus		
Hybopsis aestivalis	8 + 1	
Notropis lutrensis	101	
Notropis oxyrhynchus	20	UT-TNHC 12206
Notropis buccula	43	UT=TNHC 12200
Pimephales vigilax	1	
Centrarchidae		
Lepomis cyanellus	3	
Ictaluridae		
Ictalurus punctatus	2	
Poeciliidae		
Gambusia affinis	34	
Centrarchidae		
Micropterus sp.	1	

Texas: Knox Co: Brazos River at FM 267. R. Wahl, A. Price, and R. Murphy. 31 July 1986. Seines. (4-16)

Cyprinidae		
Hybognathus placitus	many	
Hybopsis aestivalis	1	
Notropis lutrensis	3	
Notropis oxyrhynchus	4	UT-TNHC 12106 (gravid females)
Notropis buccula	4	UT-TNHC 12105
Cyprinodontidae		
Fundulus zebrinus	3	
Poeciliidae		
Gambusia affinis	2	

Texas: Baylor Co: Brazos River near Round Timber Cemetary, at confluence with Wagon Creek. R. Wahl, A. Price, and R. Murphy. 31 July 1986. Seines. (4-16)

Cyprinidae		
Hybognathus placitus	9	
Hybopsis aestivalis	53 + 1	
Notropis lutrensis	2 + 2	
Notropis oxyrhynchus	137	UT-TNHC 12119
Notropis potteri	4	UT-TNHC 12182
Notropis buccula	11	UT-TNHC 12223
Pimephales vigilax	1	
Ictaluridae		
Ictalurus punctatus	1	
Poeciliidae		
Gambusia affinis	11	
Centrarchidae		
Lepomis megalotis	3	

Pool habitat

Cyprinidae		
Hybognathus placitus	92 + 4	
Hybopsis aestivalis	7	
Hybopsis storeriana	1 = M. storeriana	
Notropis lutrensis	2 + 1	
Notropis oxyrhynchus	27	UT-TNHC 12169
Notropis oxyrhynchus	136	UT-TNHC 12181
Notropis buccula	3 + 3	UT-THNC 12163
Pimephales vigilax	1	
Catostomidae		
Ictiobus bubalis	1	
Poeciliidae		
Gambusia affinis	37	
Centrarchidae		
Lepomis humilus	1	

Texas: Young Co: Brazos River at State Hwy 67. R. Wahl, A. Price, and R. Murphy. 31 July 1986.

Clupeidae		
Dorosoma petenense	14	
Cyprinidae		
Hybognathus placitus	144	
Notropis buccula	1	
Notropis oxyrhynchus	17	
Atherinidae		
Menidia beryllina	50	

Texas: Young Co: Brazos River at FM 209. R. Wahl, A. Price, and R. Murphy. 31 July 1986. Seines. (4-18)

Clupeidae		
Dorosoma petenense	90	
Cyprinidae		
Hybognathus placitus	64	
Hybopsis aestivalis	1	
Notropis oxyrhynchus	374	UT-TNHC 12162
Notropis buccula	4 + 4	UT-TNHC 12158
Atherinidae		
Menidia beryllina	32	

Texas: Young Co: Brazos River at State Hwy 79. R. Wahl, A. Price, and R. Murphy. 31 July 1986. Seines. (4-19)

Clupeidae		
Dorosoma petenense	73	
Cyprinidae		
Hybognathus placitus	19	
Notropis lutrensis	11	
Notropis oxyrhynchus	71	UT-TNHC 12218
Notropis buccula	6 + 2	UT-TNHC 12219

Texas: Shackleford Co: Clear Fork of the Brazos River at U.S. Hwy 183/283. R. Wahl, A. Price, and R. Murphy. 1 August 1986. Seines.

Cyprinidae		
Notropis lutrensis	244	
Notropis buchanani	8	UT-TNHC 12156
Pimephales vigilax	5	
Poeciliidae		
Gambusia affinis	5	

Texas: Stephens Co: Clear Fork of the Brazos River at FM 578. R. Wahl, A. Price, and R. Murphy. 1 August 1986. Seines.

Cyprinidae	
Notropis buchanani	2
Notropis lutrensis	260
Pimephales promelas	2
Pimephale vigilax	1
Poeciliidae	
Gambusia affinis	2
Centrarchidae	
Lepomis megalotis	4

TEXAS PARKS AND WILDLIFE DEPARTMENT
HEART OF THE HILLS RESEARCH STATION

Texas: Garza Co: Double Mountain Fork of the Brazos River at Hwy 84 crossing at Justiceburg. G. Garrett, Garrett, and D. Mosier. 11 March 1978.

Cyprinidae		
Notropis lutrensis	12	= C. lutrensis
Notropis buccula	35	
Hybognathus placitus	29	
Pimephales promelas	1	
Cyprinodontidae		
Cyprinodon rubrofluviatilis	20	
Fundulus zebrinus	25	
Poeciliidae		
Gambusia affinis	10	

Tulane University Collection

Tulane Catalog Number = TU_____

Texas: Young Co.: Brazos R., Salt fork 1.5 mi. W. Newcastle on TX 24. Kuris and Clark (#KUR 411). 28 March 1968.

Notropis bairdi 188 specimens TU 92596

Texas: Bosque Co.: trib. (?) to Brazos R. 4.0 mi. S. Whitney Dam. R.D. Suttkus and Anderson (RDS 2277). 8 April 1952.

Notropis bairdi 16 specimens TU 4993

Texas: Brazos Co.: Brazos R. at "Mussel Shoals" end of FM 1688, 8.0 mi. W. of Bryan. J.V. Conner and R. Hodson (JVC 393). 31 December 1970.

Notropis buccula 15 specimens TU 69572

Texas: Brazos Co.: Brazos R. at "Mussel Shoals" end of FM 1688, 8.0 mi. W. of Bryan. J.V. Conner, R. Hodson, L. Martin (JVC 480). 21 April 1971.

Notropis buccula 25 specimens TU 69528

Texas: Kent Co.: Salt Fork Brazos 12 mi. W. of Jayton. Arden L Walker. 25 March 1960.

Notropis bairdi specimens TU 39869

Texas: Stonewall Co.: Double Mountain Fork 11.3 mi. S. of Aspermont, Hwy 83. R.S. Suttkus, Negus, Gould, Shoop (RSS 2780).

Notropis buccula (bairdi) TU 20223

UNIVERSITY OF TEXAS AT AUSTIN
MEMORIAL MUSEUM
TEXAS NATURAL HISTORY COLLECTION (UT-TNHC)

Texas: Palo Pinto: Brazos R. at confluence of Veal Creek (Veale), below Possum Kingdom Reservoir (Veale Creek is a tributary just above Possum Kingdom).

Notropis buccula	9 specimens	UT-TNHC 1256

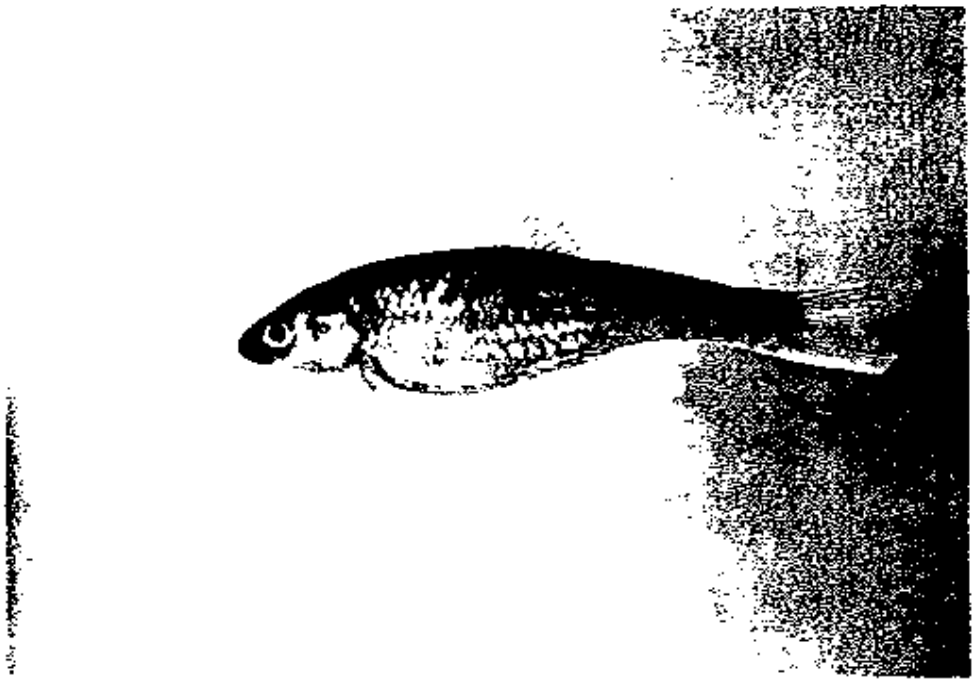
Texas: Travis Co: Mouth of Waller Creek. B. Cooper and L. Younger. June 1952.

Notropis buccula	1 specimen	UT-TNHC 2635

(Introduction or error?)

APPENDIX III

PHOTOGRAPHS OF HABITATS AND FISH SPECIMENS



PHOTOGRAPH NO. 1

Notropis buccula Cross

Texas: Kent Co: Double Mountain Fork of the Brazos River at SH 208 south of Clairemont. K.B. Mayes and J. Glass. 14 May 1992. (T.L. = 64 mm, S.L. = 49 mm) Photograph by R.E. Moss.

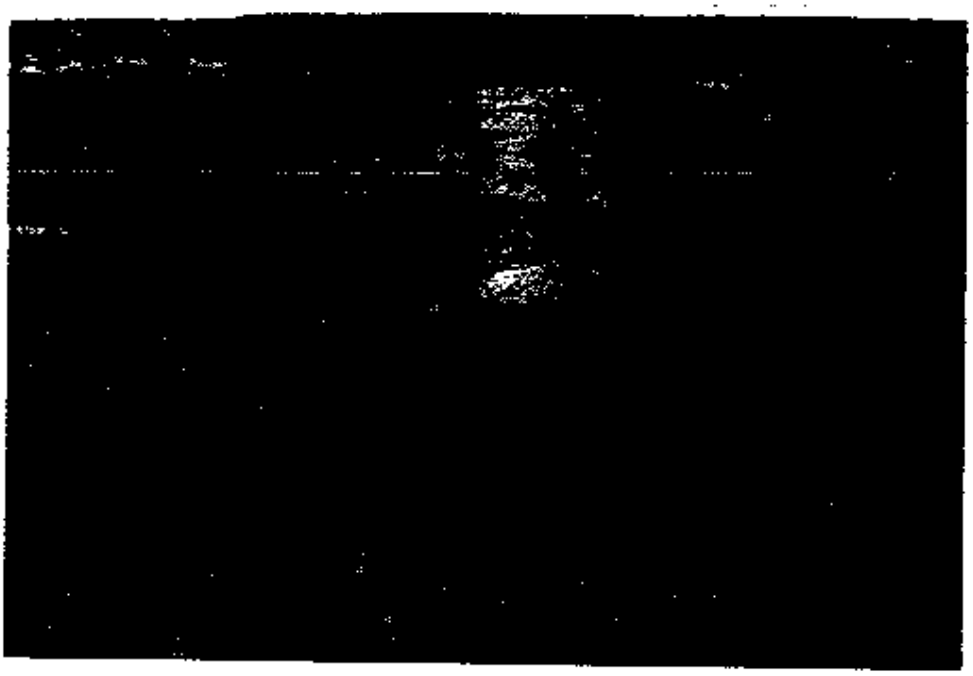
PHOTOGRAPH NO. 2

Notropis oxyrhynchus Hubbs & Bonham

Texas: Knox Co: Salt Fork of the Brazos River at SH 222 west of Knox City. R.E. Moss, K.B. Mayes, and K. Saunders. 23 August 1991. (T.L. = 66 mm, S.L. = 53 mm) Photograph by R.E. Moss.

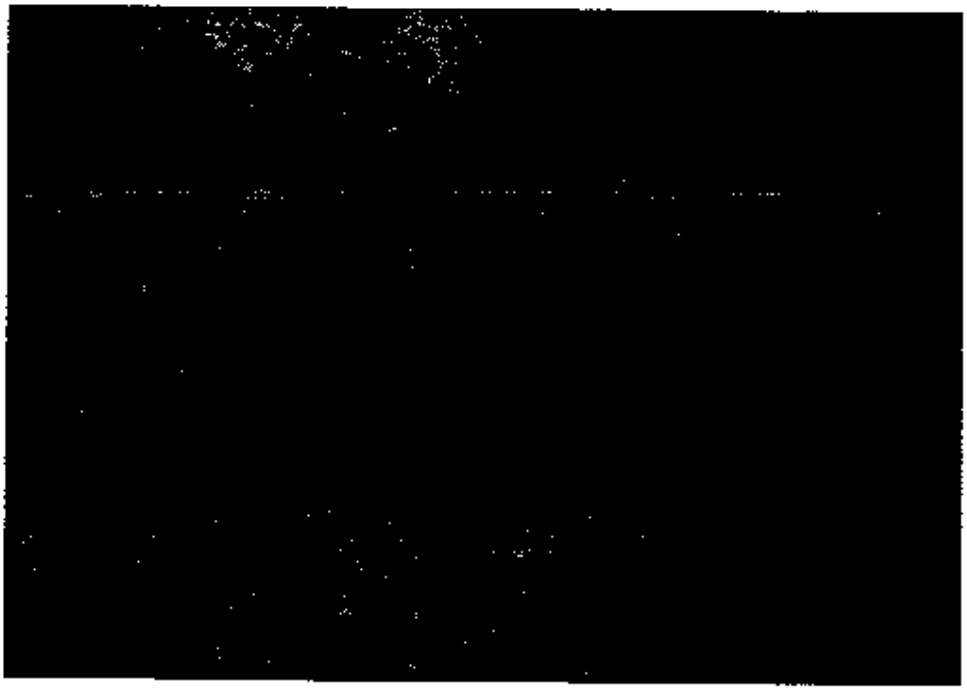
PHOTOGRAPH NO. 3

Texas: Fisher Co: Double Mountain Fork of the Brazos River at SH 70. 22 August 1991. Photograph by R.E. Moss.



PHOTOGRAPH NO. 4

Texas: Garza Co: North Fork of the Double Mountain Fork Brazos River on U.S. 380 east of Post. 21 August 1991. Photograph by R.E. Moss.



PHOTOGRAPH NO. 5

The shifting aquatic sand dunes of the Brazos River system.

Texas: Kent Co: Salt Fork of the Brazos River at Hwy 380 east of Clairemont. 22 August 1991. Photograph by R.E. Moss.

PHOTOGRAPH NO. 6

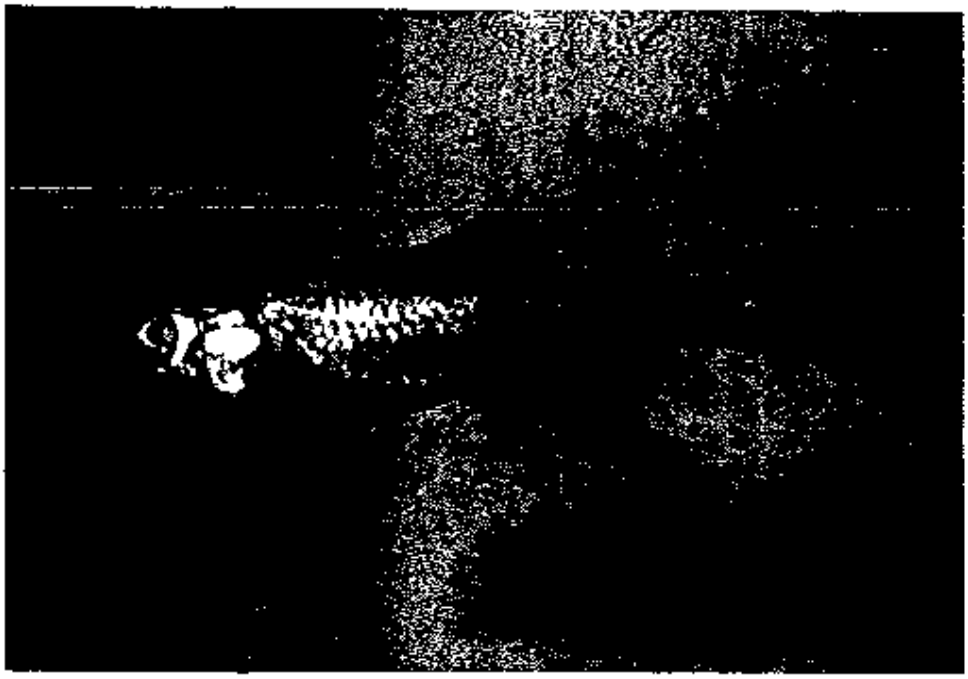
Ken Saunders and Kevin Mayes recording current velocities from a grid of habitat cells.

Texas: Kent Co: Salt Fork of the Brazos River at Hwy 380 east of Clairemont. R.E. Moss, K.B. Mayes, and K. Saunders. 22 August 1991. Photograph by R.E. Moss.

PHOTOGRAPH NO. 7

Notropis potteri Hubbs & Bonham

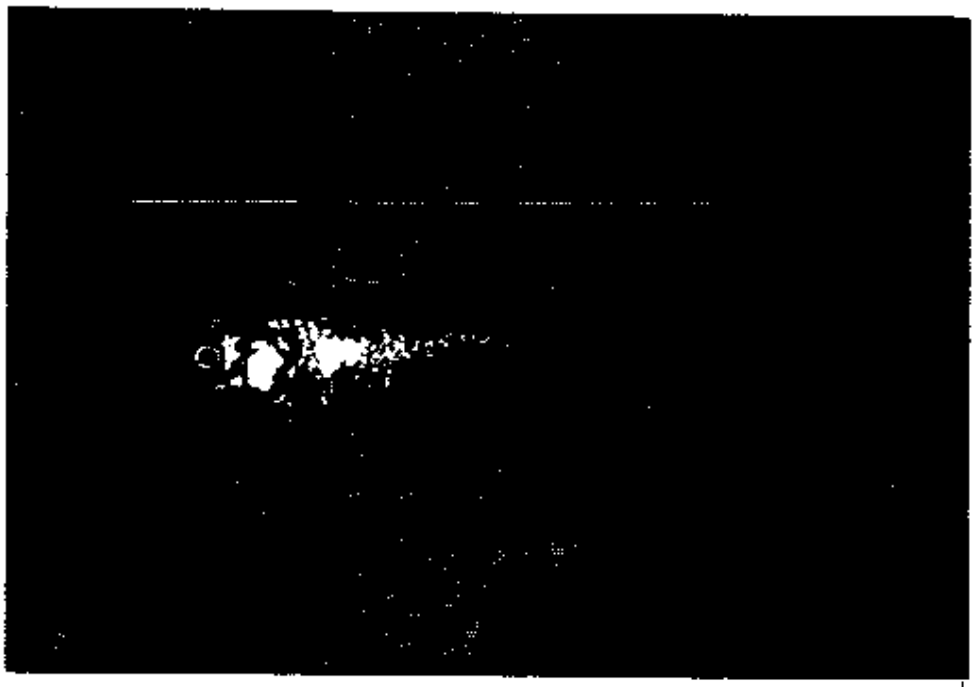
Texas: Kent Co: Double Mountain Fork of the Brazos River at SH 208 south of Clairemont. K.B. Mayes and J. Glass. 14 May 1992. (T.L. = 88 mm, S.L. = 71 mm). Photograph by R.E. Moss.



PHOTOGRAPH NO. 8

Notropis bairdi Hubbs & Ortenburger

Kansas: Meade Co: Cimarron River on K-23, Sec. 8, T 35 S, R 29 W.
F.B. Cross, R.E. Moss, and J.T. Collins. 21 July 1983.
(KU 20679) Photograph by R.E. Moss.



PHOTOGRAPH NO. 9

Notropis girardi Hubbs & Ortenburger

Kansas: Meade Co: Cimarron River on K-23, Sec. 8, T 35 S, R 29 W.
F.B. Cross, R.E. Moss, and J.T. Collins. 21 July 1983.
Photograph by R.E. Moss.

PHOTOGRAPH NO. 10

Notropis oxyrhynchus Hubbs & Bonham (?)

Colorado River drainage single specimen

Texas: San Saba and Mill Cos: Colorado River 15 miles northeast of San Saba. Lindsay and Fouquette. 16 March 1952. (HLL-8) UT-TNHC 2500. (Specimen is 44 mm in standard length). Photograph by R.E. Moss.

APPENDIX IV

LENGTH FREQUENCY DISTRIBUTIONS FOR NOTROPIS BUCCULA AND NOTROPIS OXYRHYNCHUS

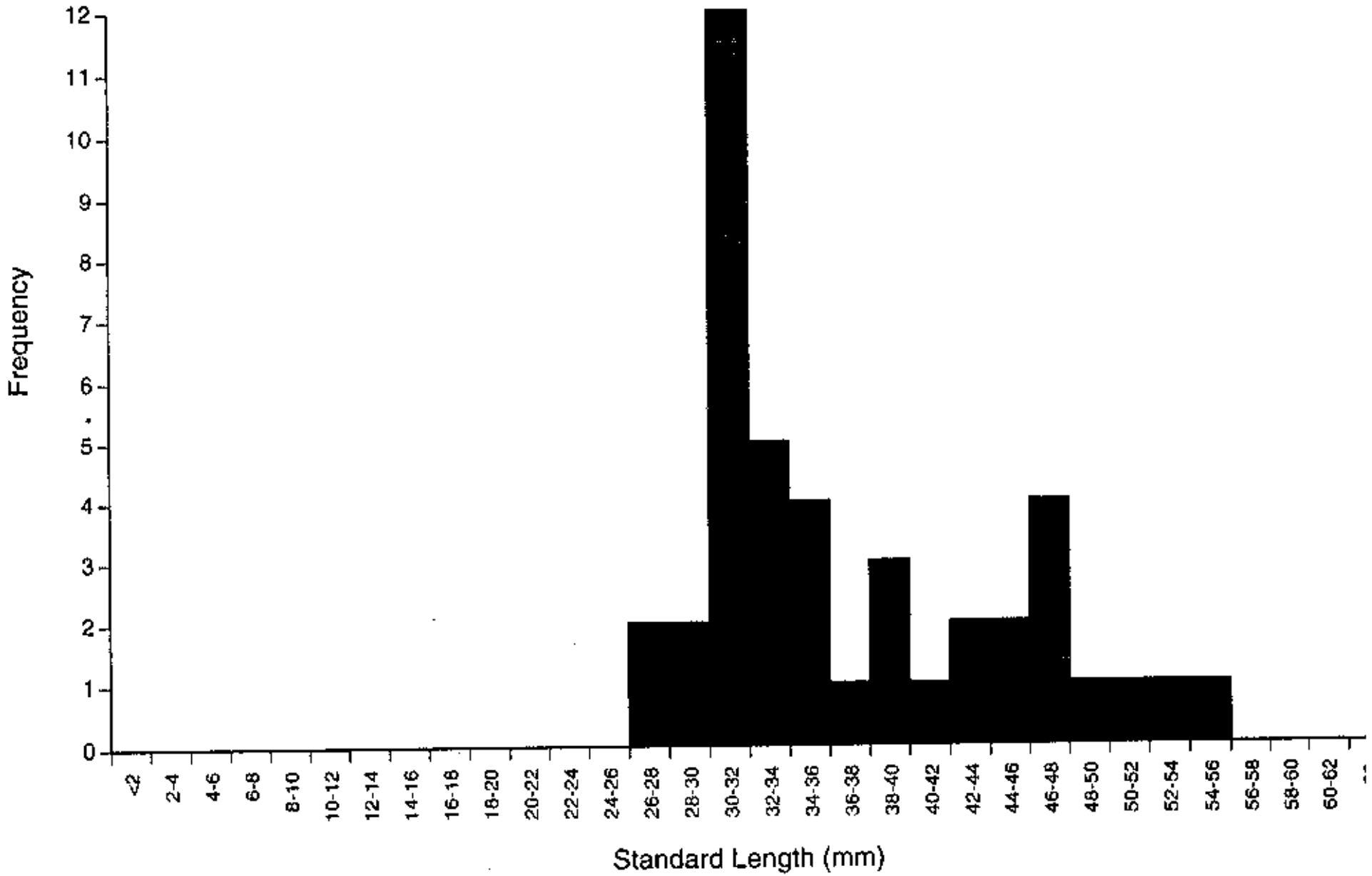


Figure 4. Length frequency distribution of Notropis buccula (n=42) from Garza Co., TX: North Fork Double Mountain Fork Brazos River at US 380 east of Post, 21 August 1991.

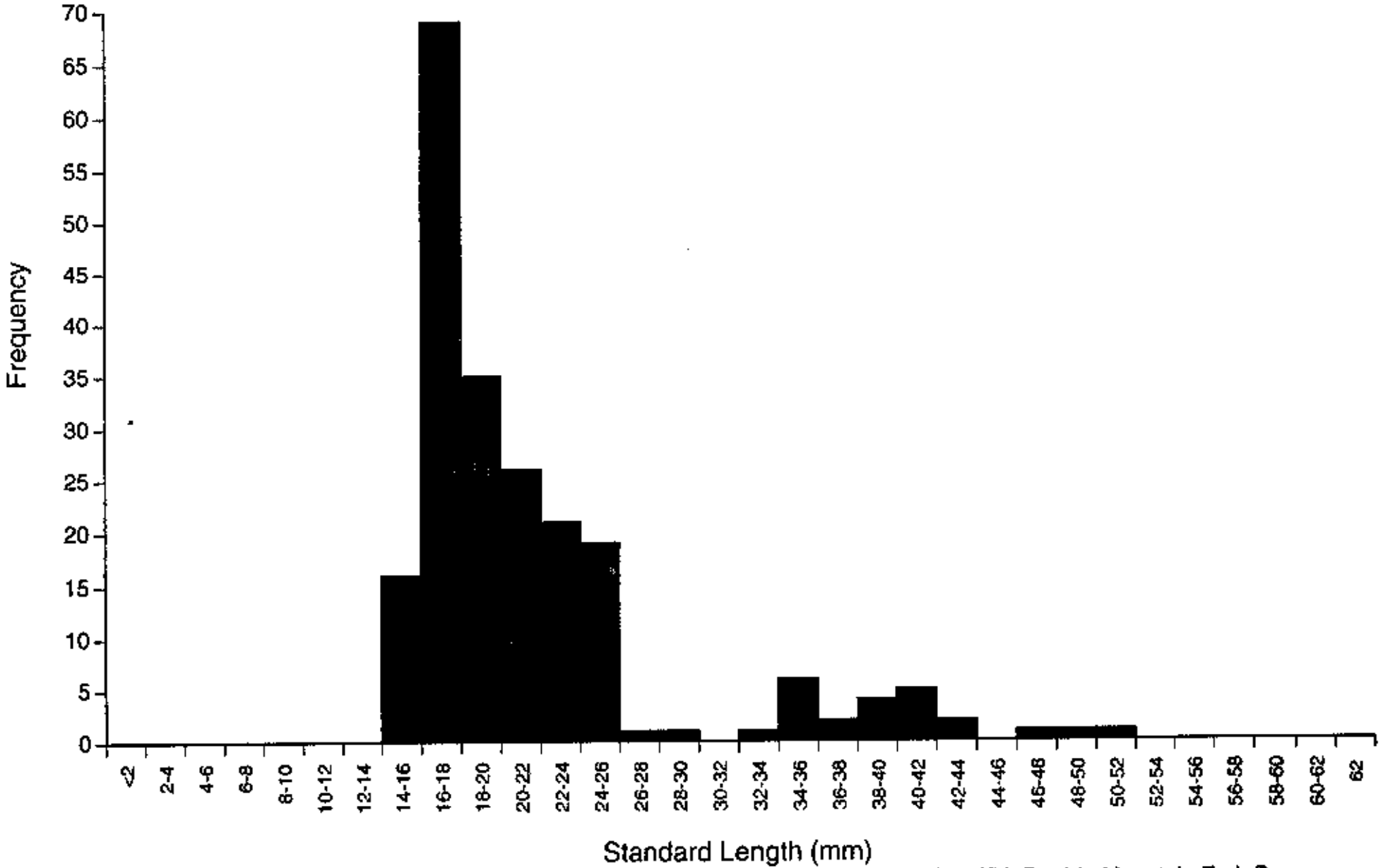


Figure 5. Length frequency distribution of Notropis buccula (n=211) from Fisher Co., TX: Double Mountain Fork Brazos River at SH 70 north of Rotan, 22 August 1991.

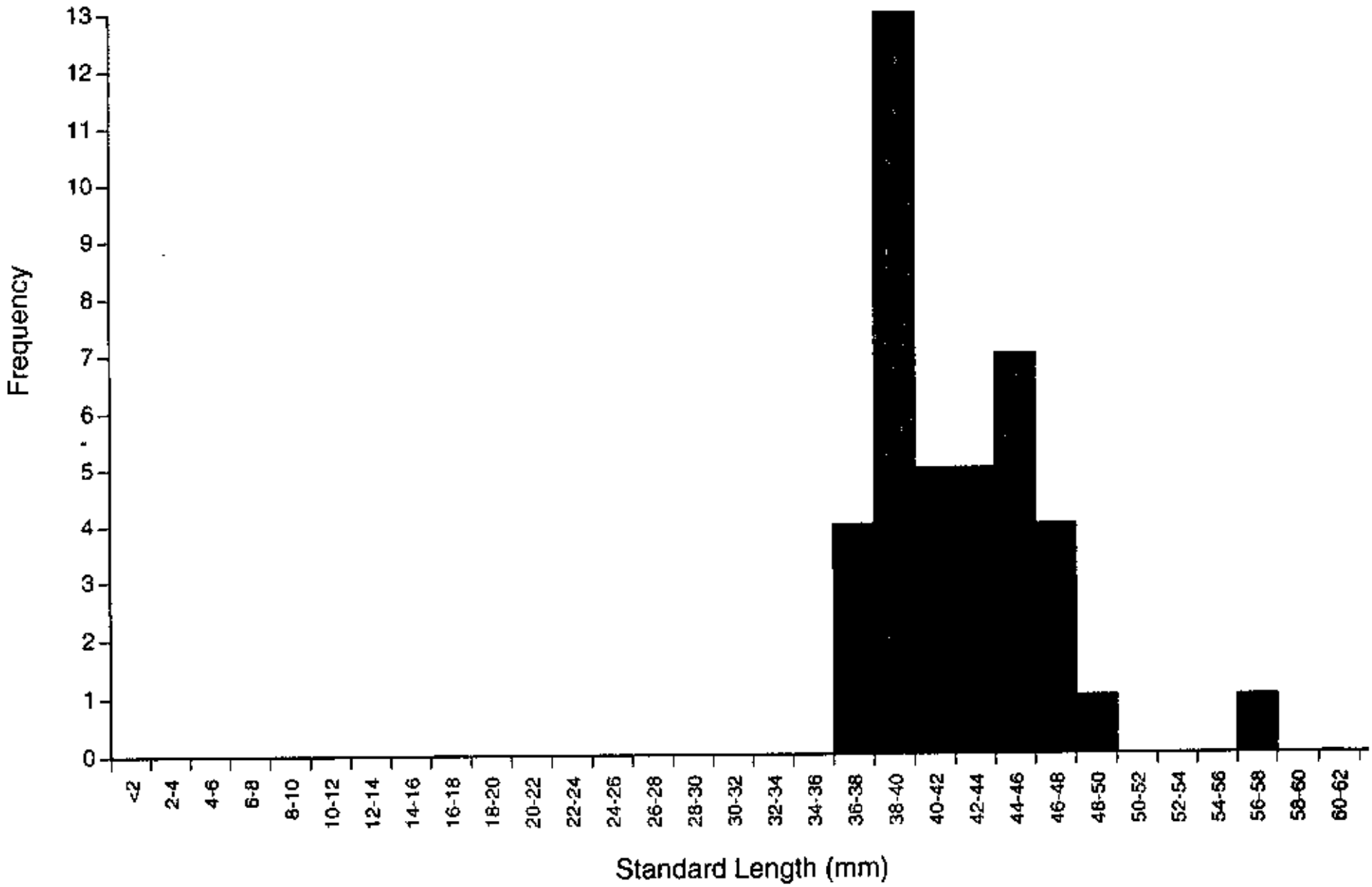


Figure 6. Length frequency distribution of Notropis buccula (n=69) from Kent Co., TX: Salt Fork Brazos River at US 380 southwest of Jayton, 8 October 1988.

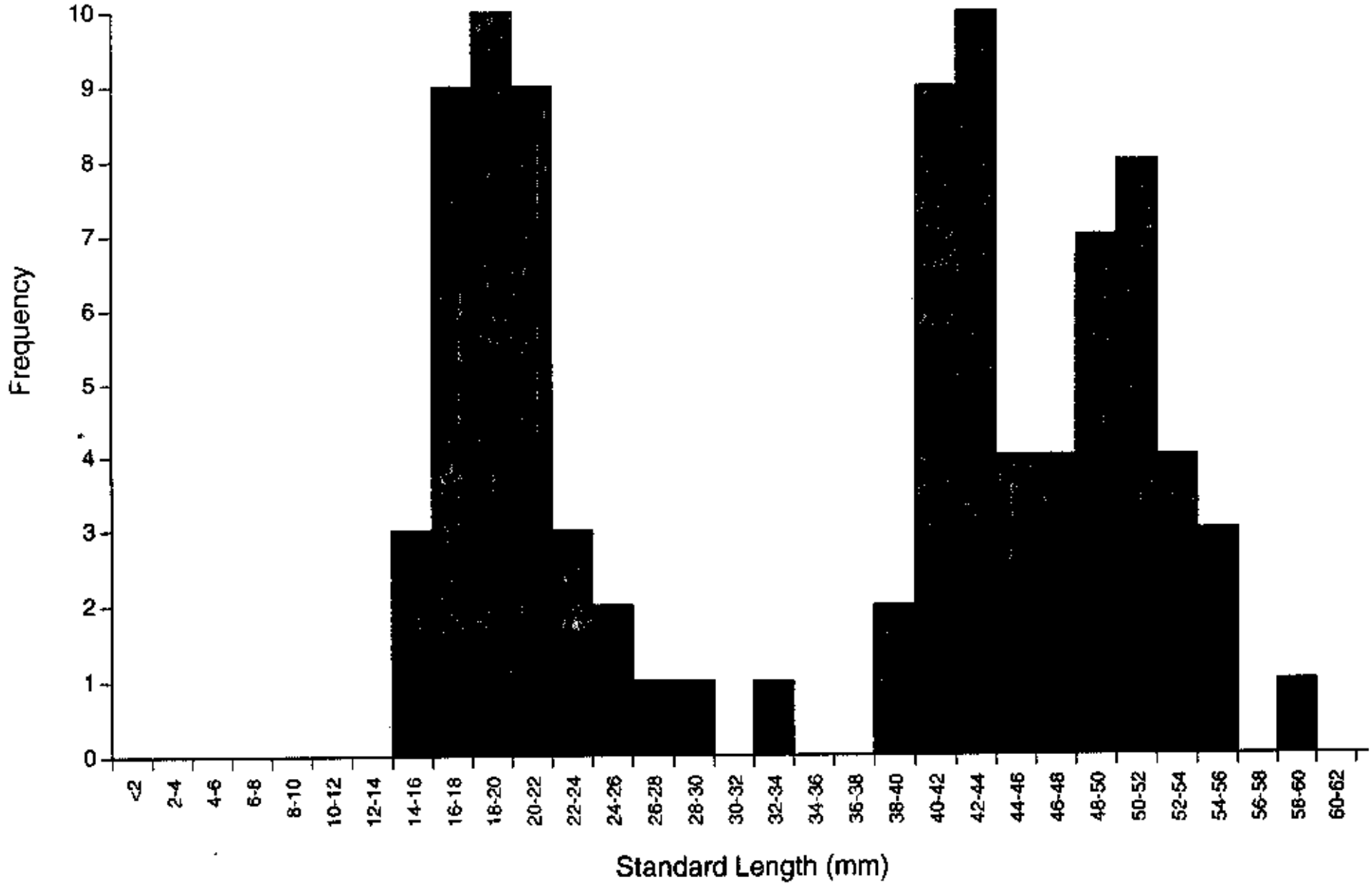


Figure 7. Length frequency distribution of Notropis buccula (n=91) from Knox Co., TX: Salt Fork Brazos River at FM 267 north of Rineland, 9 October 1988.

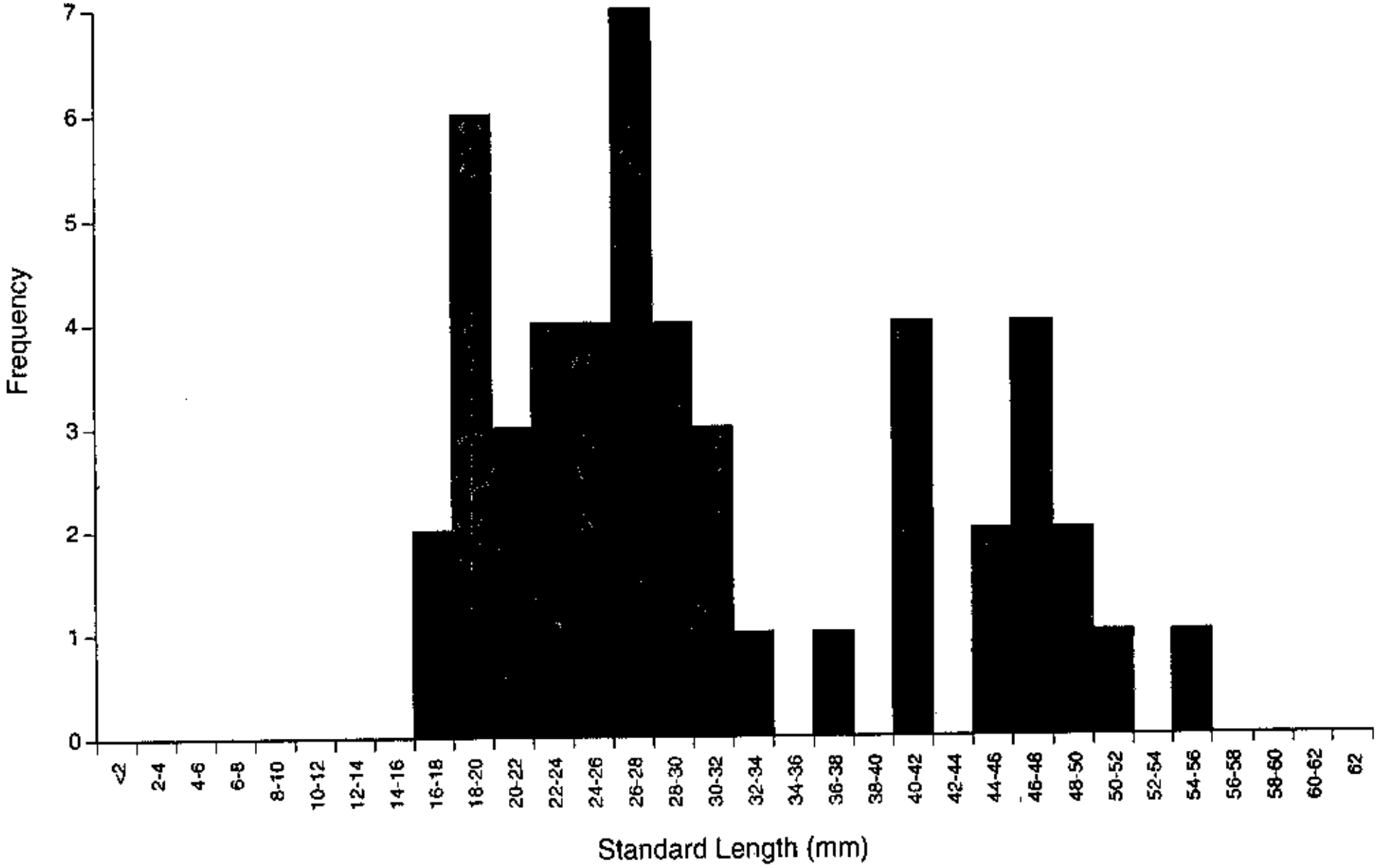


Figure 8. Length frequency distribution of Notropis buccula (n=49) from Baylor Co., TX: Salt Fork Brazos River at US 183/283 in Seymour, 8 October 1988.

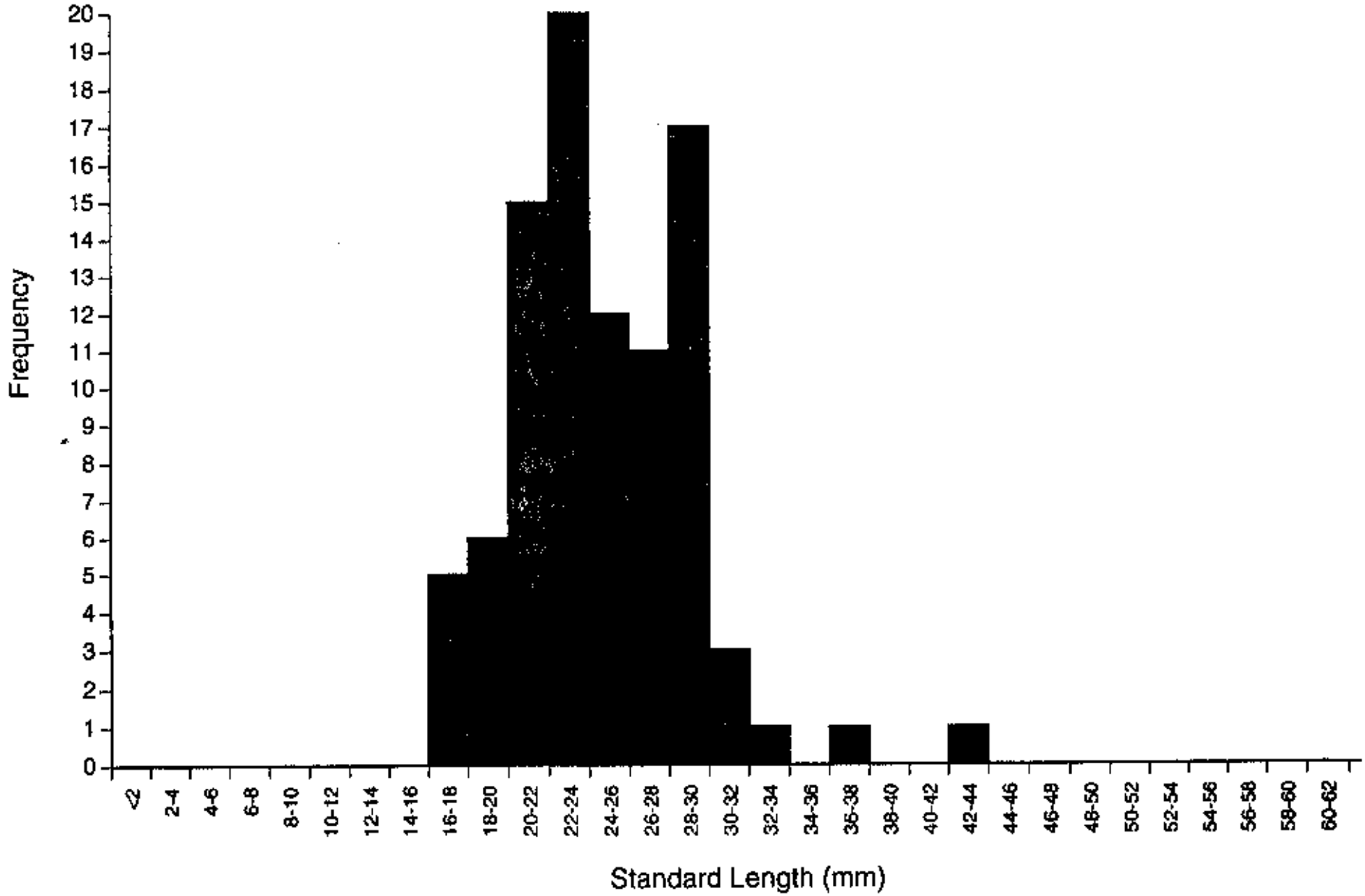


Figure 9. Length frequency distribution of Notropis buccula (n=122) from Baylor Co., TX: Salt Fork Brazos River at US 183/283 in Seymour, 16 and 17 August 1989.

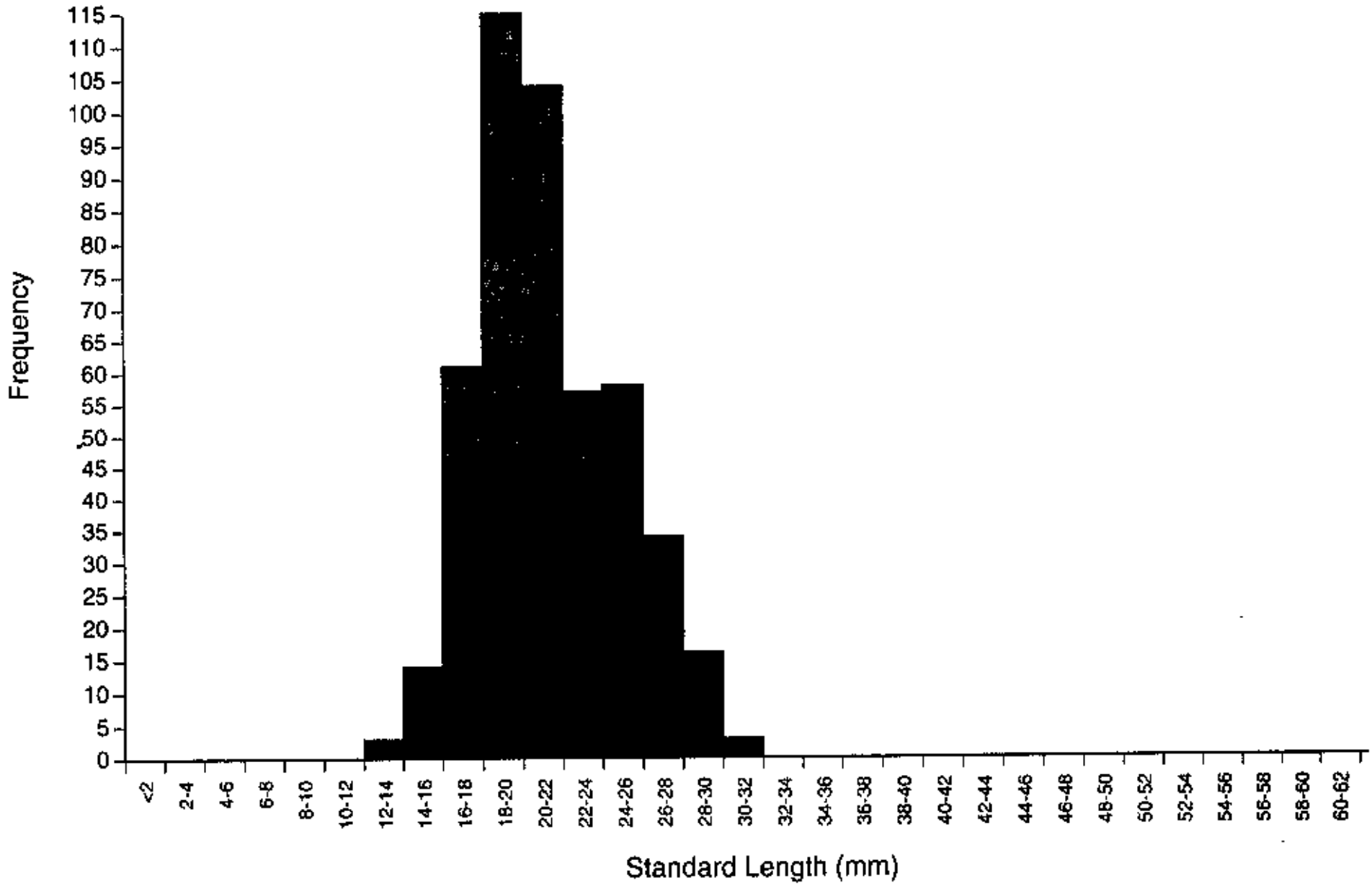


Figure 10. Length frequency distribution of Notropis buccula (n=467) from Young Co., TX: Salt Fork Brazos River at US 380 west of Newcastle, 24 August 1991.

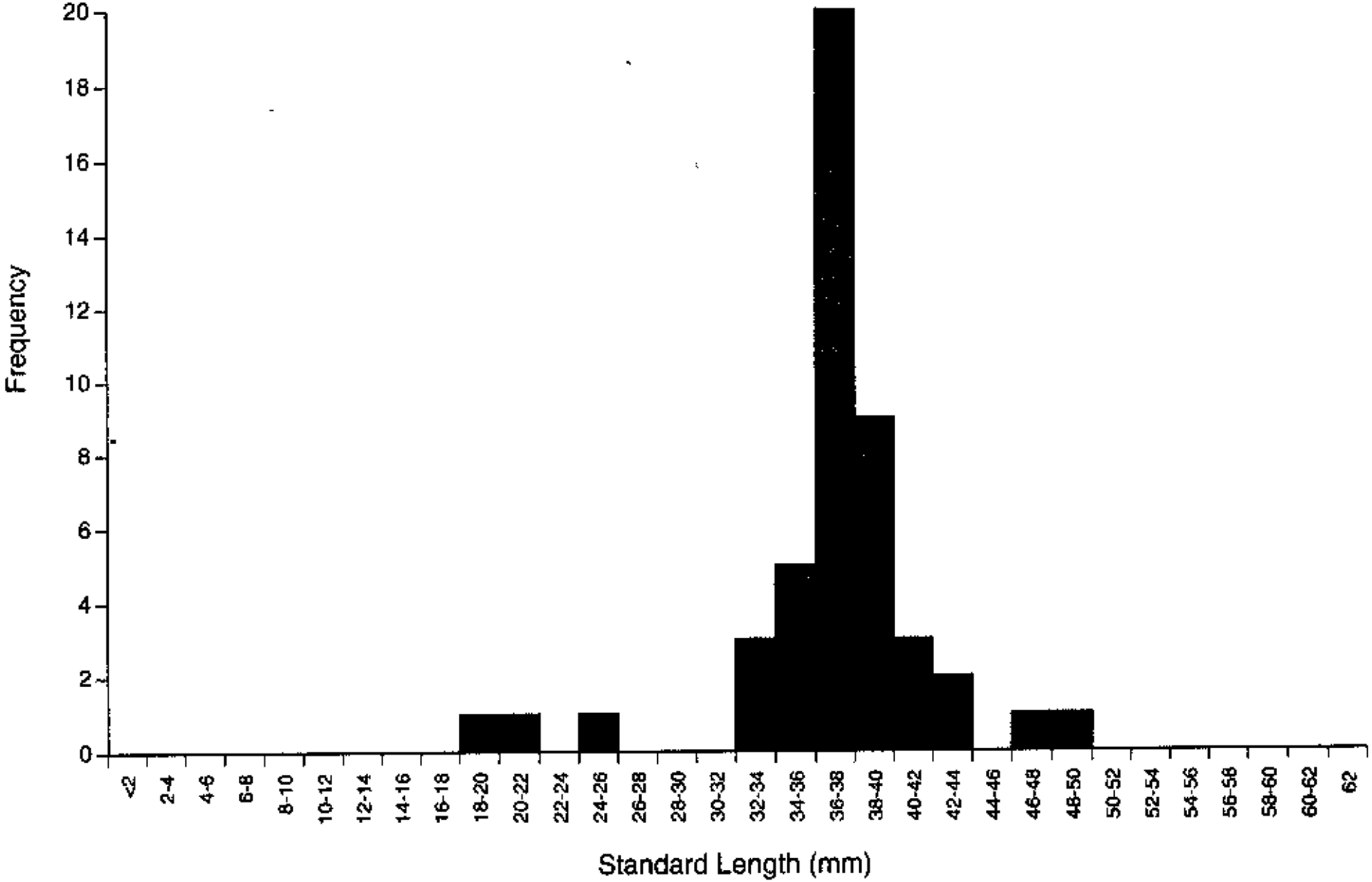


Figure 11. Length frequency distribution of Notropis oxyrhynchus (n=47) from Fisher Co., TX: Double Mountain Fork Brazos River at SH 70 north of Rotan, 22 August 1991.

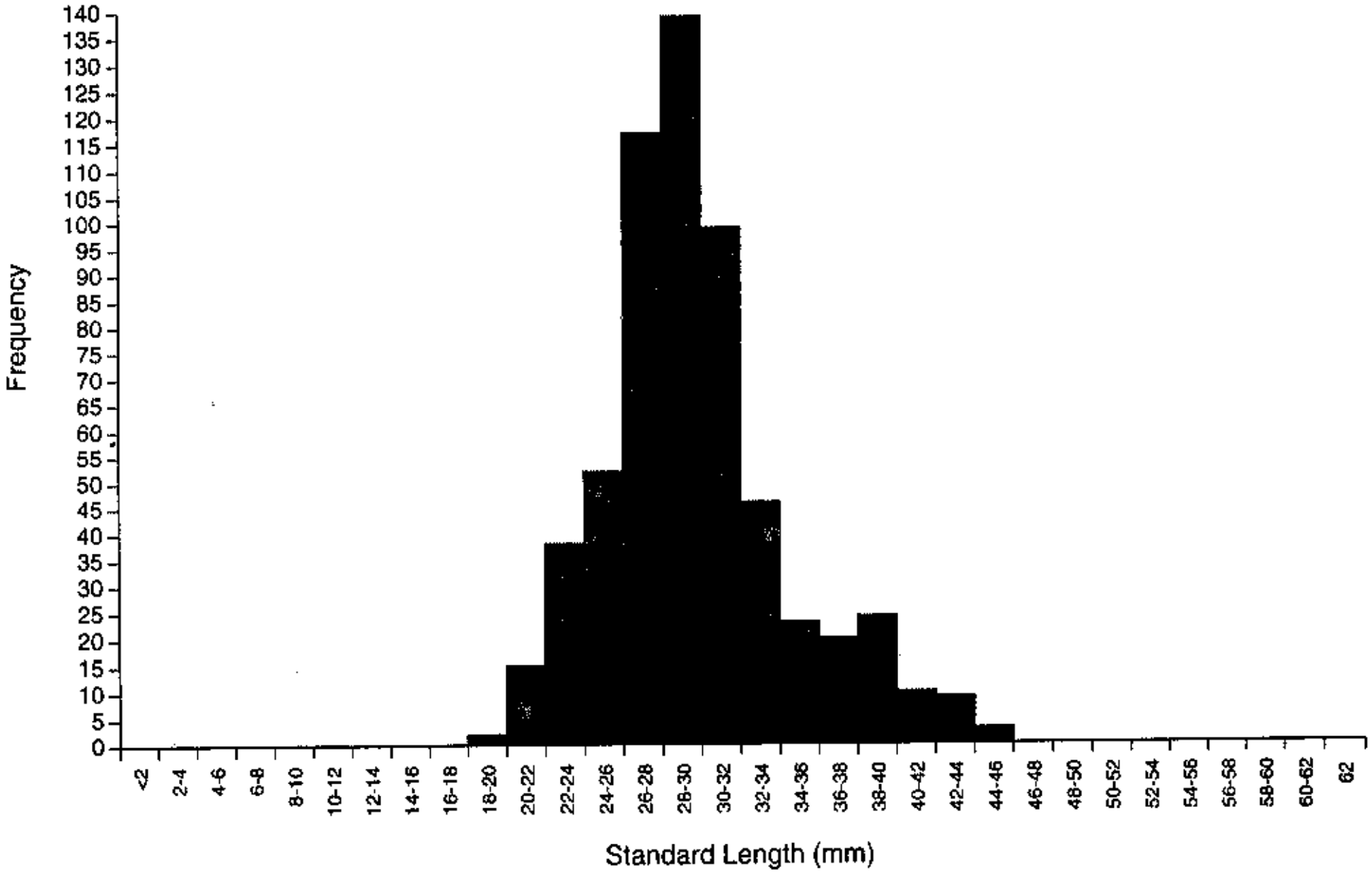


Figure 12. Length frequency distribution of Notropis oxyrhynchus (n=598) from Baylor Co., TX: Salt Fork Brazos River at US 183/283 in Seymour, 16 and 17 August 1989.

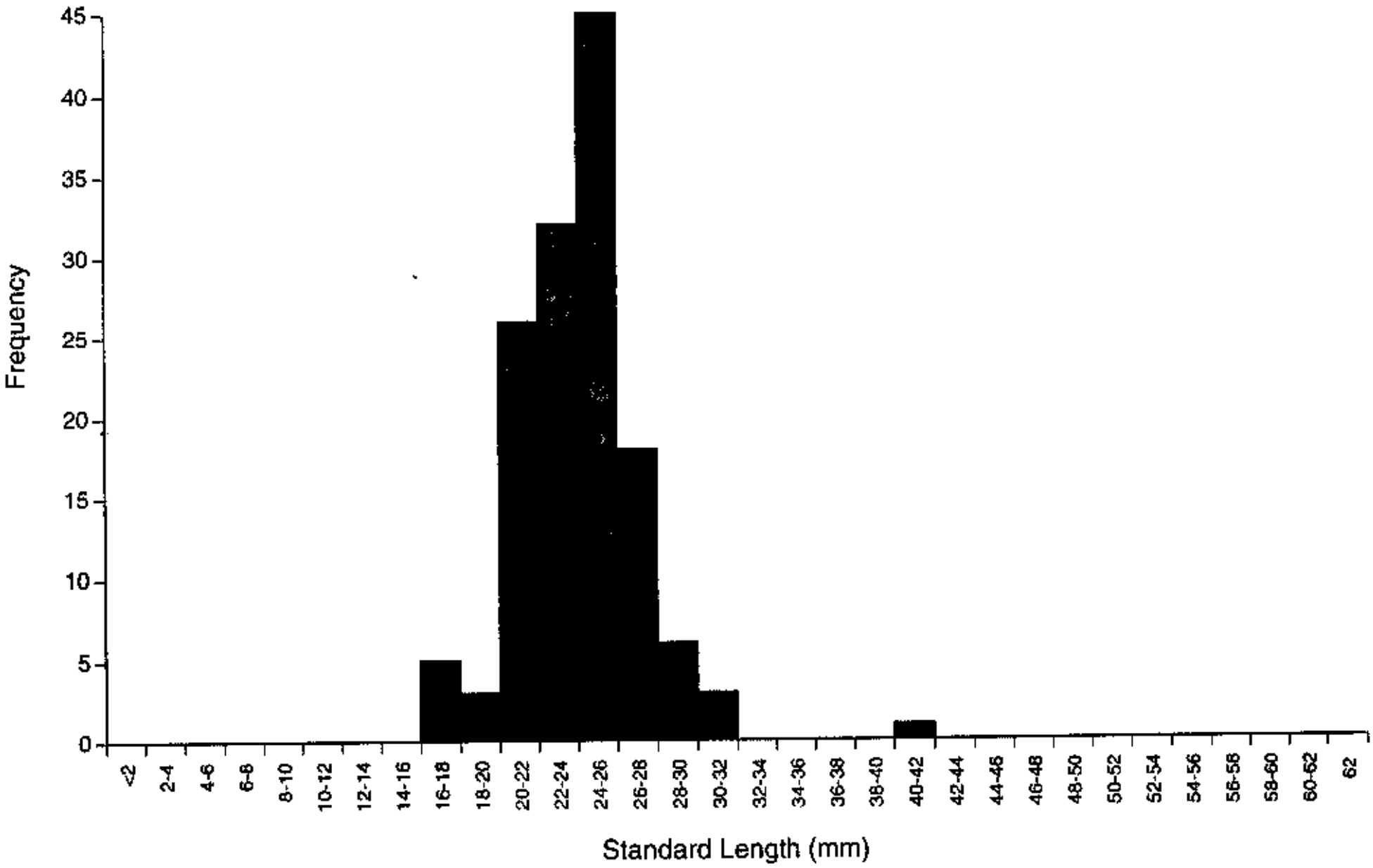


Figure 13. Length frequency distribution of Notropis oxyrhynchus (n=139) from Young Co., TX: Salt Fork Brazos River at US 380 west of Newcastle, 19 July 1990.

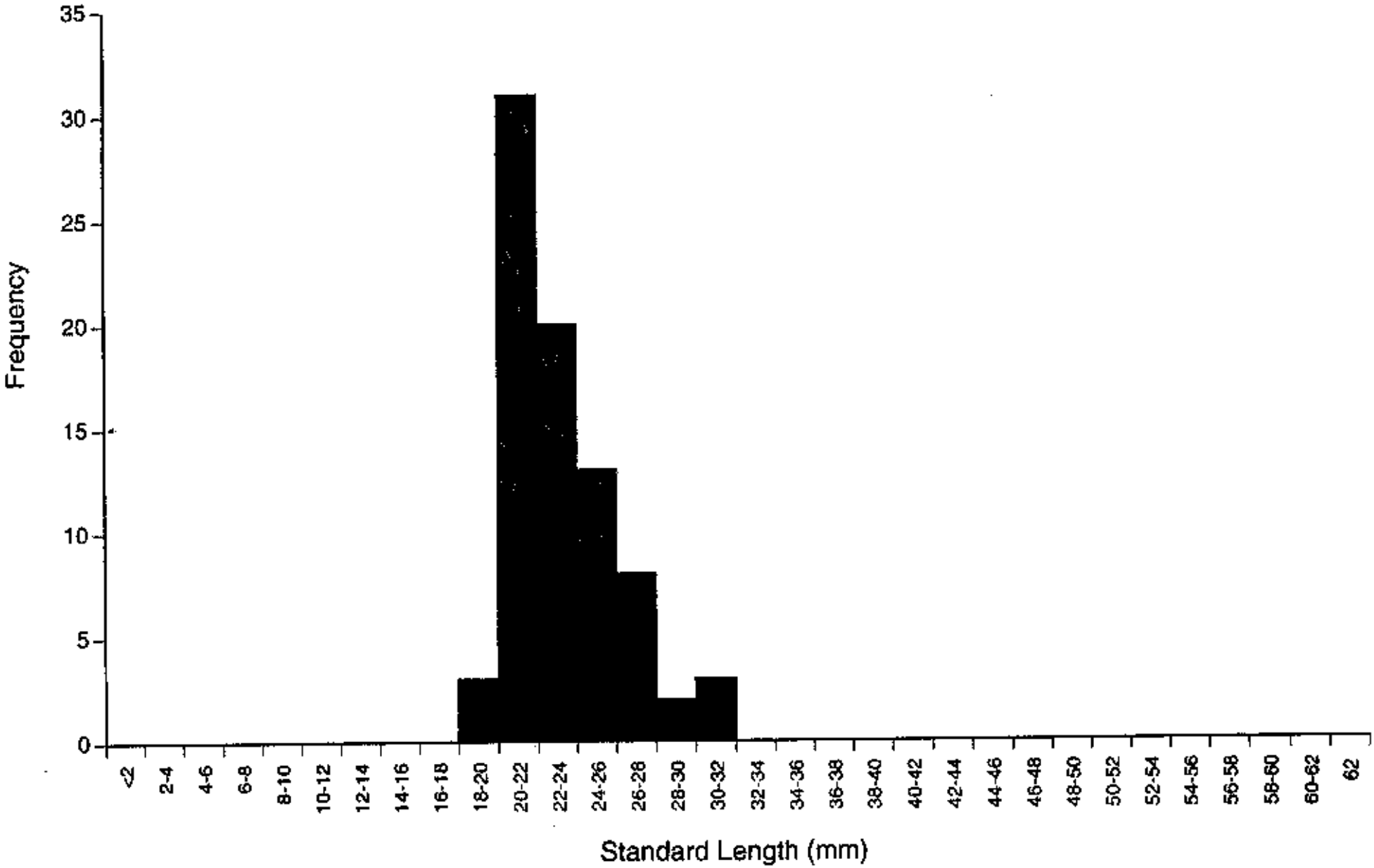


Figure 14. Length frequency distribution of Notropis oxyrhynchus (n=79) from Young Co., TX: Salt Fork Brazos River at US 380 west of Newcastle, 24 August 1991.

APPENDIX V

WATER QUALITY DATA OBTAINED FROM COLLECTION SITES.

Water quality data obtained from collection sites.

Site	Crossing	County	Date	Channel Width (ft)	DO (mg/L)	pH	Temperature (Celcius)	Conductivity (µmho/cm)	Salinity (ppt)
DM Fork	US 83	Stonewall	Aug 15, 1989	180	6.5	7.7	34.7	8780	
DM Fork	SH 208	Kent	Aug 15, 1989	102	5.8	7.9	30.2	4030	
Clear Fork	US 180	Fisher	Aug 16, 1989	33	2.9	7.6	23.7	7400	
Clear Fork	SH 6	Shackleford	Aug 16, 1989	82	7	8.1	28.4	2080	
Sandy Creek	FM 576	Stephens	Aug 16, 1989	53	7.4	8	28.8	3900	
Salt Fork	US 183/283	Baylor	Aug 16/17, 1989	132	7.1	8	28.7	5690	
Brazos River	US 180	Palo Pinto	Aug 17, 1989		7.7	7.9	28.3	3370	
Brazos River	SH 7	Falls	Aug 18, 1989	262	6.5	7.9	28.5	1020	
Salt Fork	SH 79	Young	July 19, 1990	105	7.3	7.6	24.8	1334	
Salt Fork	US 380	Young	July 19, 1990	220	7.7	7.6	27.8	1235	
Salt Fork	FM 209	Young	July 19, 1990	110	7.5	7.6	28.1	1133	
NFDM Fork	US 380	Garza	Aug 21, 1991	82	6.6	8.4	33.3	2360	0.8
DM Fork	SH 70	Fisher	Aug 22, 1991	176					
Salt Fork	SH 222	Knox	Aug 23, 1991				30	9000	4.9
Salt Fork	US 83	Stonewall	Aug 23, 1991				26	24000	13.1
Salt Fork	US 380	Young	Aug 24, 1991				30.5	4600	2.3
Brazos River	FM 485	Milam/Brazos	July 10, 1991		7.5	8.4	30.5	1750	
Brazos River	FM 1093	Fort Bend	July 23, 1991		7.6	8	30.1	897	
Brazos River	Racoon Bend Rd	Austin	July 24, 1991	450	7.4	8	30.1	1033	
Brazos River	US Mussel Shoals	Brazos	Aug 1, 1991	250					
Brazos River	Mussel Shoals	Brazos	Aug 1, 1991	250					
Brazos River	IH 20	Parker	Aug 24, 1991				29.8	2480	1.2
Lampasas River	Elm Grove Rd	Bell	July 9, 1991	62			19.6	649	
Lampasas River	Dice Grove Rd	Bell	July 9, 1991	80					
South Wichita River	SH 6	Knox	Aug 23, 1991	78			30.1	6100	3.1
North Wichita River	FM 267	Knox	Aug 23, 1991	112			32.1	7900	3.9
Wichita River	FM 1919	Baylor	Aug 23, 1991	170			32	6000	3.1
Wichita River	FM 368	Wichita	Aug 24, 1991	69			26	4700	2.8