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ENVIRONMENTAL AND CULTURAL RESOURCES WITHIN THE TRINITY RIVER BASIN

Assembled By

JAMES V. SCISCENTI

With Sections By

JOHN E. UBELAKER

WILLIAM F. MAHLER

ROBERT D. HYATT

MICHAEL L. SCOTT

S. ALAN SKINNER

JAMES V. SCISCENTI

DAVID GILLETTE and JOHN T. THURMOND

Report submitted to the Corps of Engineers, Fort Worth District by Southern Methodist University, through the Institute for the Study of Earth and Man in final fulfillment of Contract DAW63-71-C-0075.

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The passage of the National Environmental Policy Act (Public Law 91-190) represented a major reorientation in the methods of planning and the kinds of variables which must be included and properly assessed on governmental projects which alter the face of the landscape. This environmental impact report endeavored to solve questions about the Trinity Basin with each contributor collecting specimens in order to provide an inventory of botanic or zoological species. Additionally, paleontological-archaeological sites on the Trinity River were catalogued for future investigative studies.

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FORWARD

In the spring of 1971, Southern Methodist University undertook a project to review the botanical, zoological, paleontological, and archaeological literature of the Trinity River Basin of Texas under Contract DACW 63-71-C-0075 with the Corps of Engineers, Fort Worth District; the succeeding report is in final fulfillment of the contract. The project, which developed out of a series of discussions between University and Corps personnel, attempts to clarify some of the problems in the data basis for Impact Statements and pinpoint deficiencies in the current literature.

Although the various specialists involved in the report follow slightly different formats in presentation of the literature review, all carried out their research in terms of a series of common questions. These included

(1) Are there areas within the Trinity Basin in which detailed scientific studies are lacking or are minimal in nature?

(2) Is the literature information sufficient to evaluate the significance and distribution of resources within areas to be affected by land alteration projects including canalization of the Trinity and the construction of five reservoirs?

(3) What are the major deficiencies in the literature, what are the sources of deficiency and how can they be overcome?

(4) Based on prior studies, regardless of problem areas, is the nature of resources such that there are likely to be resource management conflicts within project areas?

During initial bibliographic review, it became readily apparent that much of the Trinity Basin lacked sufficient study. Therefore each author has attempted an inventory of botanic or zoological species or paleontological-archaeological sites for the Basin at large. From this inventory, a number of problem-oriented investigations can be developed to overcome the current literature deficiencies.

A number of persons took an active part in the report. L. E. Horsman, Chief of the Environmental Resources Section and Durwood Jones of the Corps of Engineers, Fort Worth District were helpful in all phases of the project, particularly in clarifying necessities of Environmental Impact Statements. Robert Slaughter, Director of the Shuler Museum of Paleontology at Southern Methodist University acted in an advisory capacity in terms of paleontological problems. The late Dr. William B. Heroy, Director of the Institute for the Study of Earth and Man at Southern Methodist University actively encouraged the project, providing use of extensive bibliographic holdings.

Illustrations were prepared by Nancy K. Sciscenti. The text was typed by Rubie Heidel and Shirley King.

James V. Sciscenti
Principal Investigator
Southern Methodist University

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CHAPTER I

ZOOLOGICAL RESOURCES IN THE TRINITY RIVER BASIN

by

John E. Ubelaker
Associate Professor
Department of Biology

Introduction

The Trinity River basin lies in the eastern half of Texas with an overall length of 360 miles. It extends from a 130 mile wide headwater region, located generally along a northwest-southeast axis from Archer County to Chambers County, to the Trinity bay. The drainage area is about 17,600 square miles.

The present report concerns a review of literature of freshwater and riparian terrestrial faunae of the Trinity River in the following counties: Chambers, Liberty, San Jacinto, Polk, Trinity, Madison, Leon, Walker, Freestone, Anderson, Houston, Limestone, Navarro, Henderson, Johnson, Ellis, Kaufman, Van Zanbt, Rockwall, Dallas, Tarrant, Parker, Young, Jack, Wise, Denton, Collin, Grayson, Cooke, Montague, Clay and Archer. In addition, records from Grimes County are included.

The classification of Texas into areas in which the requirements for animal life are relatively uniform is essential for proper interpretation of animal ecology, distribution and influence of man-made changes on such fauna. Several such classifications have been attempted. Bailey (1905) first mapped life zones for Texas, using temperature differences. Dice (1943) mapped the general distribution of the biotic provinces of North America and defined a biotic province as "a considerable and continuous geographic area and is characterized by the occurrence of or more ecological associations that differ, at least in proportional area covered, from the associations of adjacent provinces".

Blair (1950) updated the work of Dice in the state of Texas. Using the peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography and soil types, Blair (loc. cit.) recognized seven biotic provinces (Fig. 1).

For purposes of this report, all counties under consideration fall within the Austroriparian and Texan provinces. The former province includes those counties which lie east of a line running north from western Harris County to western Red River County, and approximates the western

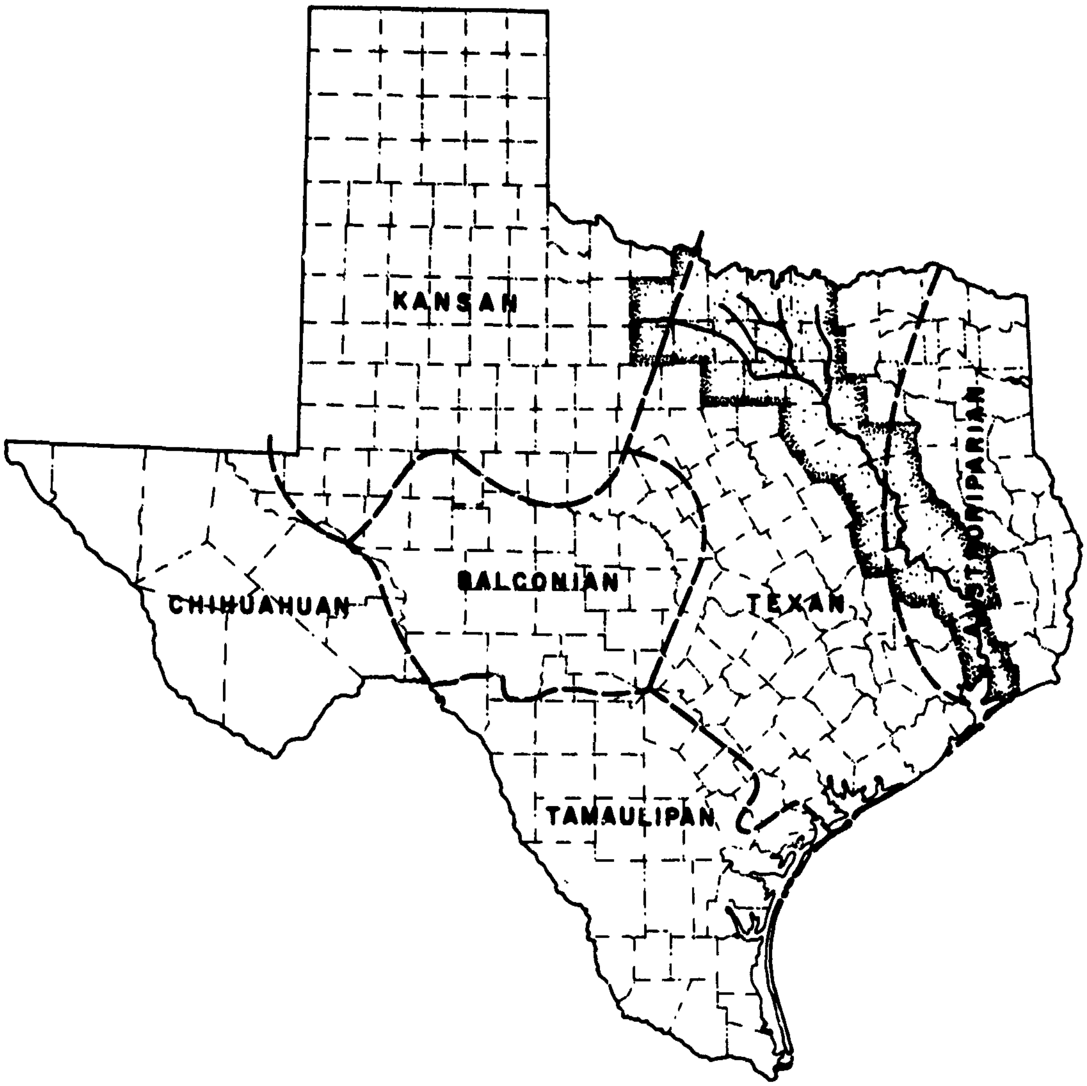

Figure 1. Biotic provinces in Texas

boundary of the main body of the mesic forests of pine and hardwoods of the eastern Gulf coastal plain from eastern Texas to the Atlantic. This boundary is arbitrary for it does not represent a physiographic break.

Of great importance to this province is the influence of the Big Thicket to the fauna of the Trinity River. This wild life area adds noticeably to the fauna of this area as can be determined in the report on the fauna of the Big Thicket by Park and Cory (1936). The fauna presented in their paper is not included in the main body of this report since many of their records cannot be verified.

The Texan province is generally regarded as an ecto-tone between the forest of the Austroriparian and Carolinian provinces and the grasslands of the western part of the state. The approximate boundary is indicated in Fig. 1.

Zoological Resources

The more important references dealing with the distribution of vertebrates and invertebrates are included with comments below. All references were obtained by searching pertinent journals for articles recording animals from those counties listed above. Unfortunately many reports list species locality data only as the Trinity River or east Texas. Where available, specific references are made to counties represented in the Tennessee Colony Reservoir. In addition to the journals, information was obtained from Masters and Ph.D. thesis at universities in central and east Texas, Technical reports, books, pamplets and the comprehensive survey report of the Trinity River and tributaries, Texas by the U.S. Army Corps of Engineers (1962). All references to organisms obtained in this manner are listed by phylum. The organism is followed by the locality data presented by the original author. The citation is in parenthesis.

Numerous problems are encountered in surveys of this type. The literature containing references to animals in a particular region is widespread. Investigators collect specimens and forward them to colleagues in other institutions in the United States and abroad. Thus, references are likely to appear occasionally in foreign journals, particularly if the organism under consideration is obscure. Investigators frequently fail to adequately state the locality where the collections occur and many references can only be inferred. There appears to be no single survey of invertebrates on the area of the Trinity River under consideration in this report. Vertebrate surveys are largely limited to game animals with other wild life receiving little attention.

Represented Taxa

AQUATIC VEGETATION (in part).

The literature citations here represent plants occurring as plankton. Other references are noted by Mahler (this report).

The aquatic plants, particularly algae, diatoms and desmids are commonly considered in limnological surveys for these planktoners contribute to the quality of water, i.e. oxygen, carbon dioxide, hydrogen-ion content, turbidity and productivity.

Algae

Anabaena spp. - Wise, Jack, Tarrant, Denton Counties (66). Harris and Silvey (64) found seasonal occurrence of this genus in four lakes (Bridgeport, Eagle Mountain, Lake Dallas and Lake Worth). Anabaena spp. occurred in the months of January, March, May, June, July, October and November in Lake Bridgeport; March, June and December in Eagle Mountain Lake; September only in Lake Dallas and February, March, June, July, August, October and November in Lake Worth. Rose (66) reported this genus in the Trinity River.

Lyngbya spp. - Wise, Jack, Tarrant, Denton Counties (64) reported seasonal occurrence of this genus. January, April, August and November in Bridgeport; February, March, August and December in Eagle Mountain Lake; July, September, October and November in Lake Dallas and February, March, July, September, October, November and December in Lake Worth.

Nostoc. spp. - Denton, Tarrant Counties (64). Harris and Silvey (64) reported this rare blue-green algae to be present only in the month of December in Lake Dallas and in March in Lake Worth.

Staurastrum spp. - Jack, Wise, Tarrant Counties (64). Harris and Silvey (64) reported this algae to be present in January, October and November in Lake Bridgeport; February, March, June, October, November and December in Eagle Mountain Lake; May, July and November in Lake Worth.

Pediastrum spp. - Jack, Wise, Tarrant, Denton Counties (64, 12). Harris and Silvey (64) reported this genus to be present in April, December in Lake Bridgeport; March to August and October to December in Eagle Mountain Lake; all months in Lake Dallas and February, May and July to December in Lake Worth.

Trochiscia spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this genus to be present in April in Lake Bridgeport; March, April, September and October in Eagle Mountain Lake; July in Lake Dallas and March, July and October in Lake Worth.

Closterium spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this genus present in the months of February, March and July in Lake Bridgeport; January, April, November and December in Eagle Mountain Lake; May, September and December in Lake Dallas and July in Lake Worth.

Spirogyra spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this algae in January and April in Lake Bridgeport; February and March in Eagle Mountain Lake; November in Lake Dallas and August in Lake Worth.

Mougeotia spp. - Jack, Wise, Denton Counties (64). Harris and Silvey (64) reported this green algae in January from Lake Bridgeport, in August from Lake Dallas and Lake Worth.

Ulothrix spp. - Jack, Wise, Denton Counties (64). Harris and Silvey (64) reported this green algae in February, March and October from Lake Bridgeport; September from Lake Dallas and Lake Worth.

Gyrosigma spp. - Jack, Wise, Denton Count Harris and Silvey (64) reported this from Lake Bridgeport; November from Lake D... and October from Lake Worth.

Dictyosphaerium spp. - Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this green algae in November from Eagle Mountain Lake and Lake Dallas; November and December from Lake Worth.

Melosira spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey reported this common diatom in January through November in Lake Bridgeport, January through August, November and December in Eagle Mountain Lake; January through May, August, September and November in Lake Dallas; and January through May, July, August, October through December in Lake Worth.

Synedra spp. - Jack, Wise, Tarrant, Denton Counties (64, 66). Harris and Silvey (64) reported this diatom in February, March, June through October in Lake Bridgeport; March, April, June through September in Eagle Mountain Lake; January, August and September in Lake Dallas; January, April, July, August, October, November and December in Lake Worth. Also Trinity River, Tarrant County.

Tabellaria spp. - Jack, Wise, Denton, Tarrant Counties (64, 66). Harris and Silvey (64) reported this diatom present in March from Lake Bridgeport; April and November from Lake Dallas and October from Lake Worth. Also Trinity River, Tarrant County (66).

Navicula spp. - Jack, Wise, Denton, Tarrant Counties (64, 66). Harris and Silvey (64) reported this diatom present in February through May, July and October in Lake Bridgeport; March only in Eagle Mountain Lake; April and September in Lake Dallas and July only from Lake Worth. Also Trinity River(66).

Oedogonium spp. - Jack, Wise, Denton Counties (64). Harris and Silvey (64) reported this green algae present only in March from Lake Bridgeport and in April from Lake Dallas.

Aphanizomenon spp. - Jack and Wise Counties (64). Harris and Silvey (64) reported this blue-green algae only in the month of March from Lake Bridgeport.

Pinnularia spp. - Jack and Wise Counties (64). Harris and Silvey (64) reported this diatom only in the month of July from Lake Bridgeport.

Fragilaria spp. - Jack, Wise, Tarrant Counties (64, 66). Harris and Silvey (64) reported this diatom only in the month of October from Lake Bridgeport. Also from Trinity River, Tarrant County (66).

Oscillatoria spp. - Jack, Wise, Denton Counties (64). Harris and Silvey (64) reported this blue-green algae in May and October from Lake Bridgeport; September from Lake Dallas; July, September, October and December from Lake Worth.

Micrasterias spp. - Denton County (12)

Docidium spp. - Denton County (12)

Compylodiscus spp. - Denton County (12)

Staurastrum spp. - Denton County (12)

Desmidium spp. - Denton County (12)

Cosmarium spp. - Denton County (12)

Arthrodesmus spp. - Denton County (12)

Berimnopedia - Trinity River, Tarrant County (66)

Hiorecyatia - Trinity River, Tarrant County (66)

Oseillatoria - Trinity River, Tarrant County (66)

Spirulina - Trinity River, Tarrant County (66)

Botryococcus - Trinity River, Tarrant County (66)

Dinobryon - Trinity River, Tarrant County (66)

Synura - Trinity River, Tarrant County (66)

Asterionella - Trinity River, Tarrant County (66)

Meridion - Trinity River, Tarrant County (66)

Stephanodiscus - Trinity River, Tarrant County (66)

Surirella - Trinity River, Tarrant County (66)

Actinastrum - Trinity River, Tarrant County (66)

Chaetophora - Trinity River, Tarrant County (66)

Cladophora - Trinity River, Tarrant County (66)

Coelastrum - Trinity River, Tarrant County (66)

Dictyosphaerium - Trinity River, Tarrant County (66)

Stewart and co-workers (71, 72, 73, 74) have reported additional algae and fungi from North Texas waters. These species are listed below.

Anabaena
Anacystic
Arthrospira
Chroococcus
Gloeothace
Lyngbya
Merismopedia
Microcystis
Nostoc
Oscillatoria
Phormidium
Rivularia-like
Ankistrodesmus spiralis
A. sp.
Bracteacoccus
Chlamydomonas

Chlorella ellipsoidea
Chlorella sp.
Chlorococcum
Cosmarium
Chlorosarcina
Coelastrum
Cladophora
Eudorina
Nannochloris
Oocystis
Penium
Pediastram tetras
Protococcus
Selenastrum
Stichococcus
Chloridella
Fusarium (fungi)
Gleocystis
Scenedesmus
Navicula
Tetraspora
Nitzschia
Pinnularia

The data presented by Harris and Silvey (64) indicated significant differences both qualitatively and quantitatively throughout the year at each site. Their studies emphasize the necessity of careful sampling throughout the year to adequately obtain samples.

PHYLUM PROTOZOA

Vorticella spp. - Jack, Wise Counties (64, 12). Harris and Silvey (64) reported this stalked ciliate as present only in the month of June in Lake Bridgeport.

Arcella spp. - Jack, Wise, Denton Counties (64, 12). Harris and Silvey (64) reported this amoeba in June, July and October from Lake Bridgeport; June and July from Lake Dallas and July and September from Lake Worth.

Ceratium spp. - Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this flagellate in January, February and March, June, July, August, October, November and December from Eagle Mountain Lake; June, August and September from Lake Dallas and in February, March, May, June through November in Lake Worth.

Paramecium spp. - Wise, Jack, Tarrant, Denton Counties (64, 12, 72). Harris and Silvey (64) reported this ciliate in November from Lake Bridgeport; in January, February, June and December from Eagle Mountain Lake; in September from Lake Dallas and in July from Lake Worth. Cheatum (12) has collected this organism from the Trinity, White Rock Lake, Denton County, Texas.

Actinosphaerium spp. - Wise, Jack, Tarrant, Denton Counties (64, 75). Harris and Silvey (64) reported this ciliate in October from Lake Bridgeport; in June and December from Eagle Mountain Lake; in May and September from Lake Dallas and in July from Lake Worth. Also North Texas (75).

Halteria spp. - Tarrant County (65). No location given.

Difflugia spp. - Jack, Wise, Tarrant and Denton Counties (64). Harris and Silvey (64) reported the seasonal occurrence of this genus as: January, March through August from Lake Bridgeport; January through August, October and December from Eagle Mountain Lake; January through June and August through November from Lake Dallas; and January through March, May through August and October through December from Lake Worth.

Cheatum (12) has collected the following additional genera from the Trinity River in Dallas, White Rock Creek and Lake: *Coratium* sp., *Dinobryon* sp., *Heliozoa* sp. Hawley (65) listed *Trachelocerca*, *Nuclearia simplex*, *Blepharisma lateritia*, *Paramecium*, *Euplotes charon*, *Coleps hirtus*, *Euglena* and *Vorticella campanula* from Texas waters. Specimens were probably collected in Tarrant, Parker, Wise, Denton or Dallas Counties.

Rose (66) determined several genera of protozoa collected from the Trinity River in Tarrant County. She listed the following 22 genera: Ceratium, Eudorina, Euglena, Pandorina, Peridinium, Phacus, Volvox, Actinophrys Amoeba, Arcella, Centropyxis, Diffulgia, Coleps, Colpidium, Didinium, Holophyra, Loxophyllum, Paramecium, Prorodon, Stentor Styloninchia and Vorticella.

Bodo - Garza Little Elm Reservoir, Denton County (72, 73, 74, 75)
Monochilum - Garza Little Elm Reservoir, Denton County (72)
Vahlkampfia - Garza Little Elm Reservoir, Denton County (72)
Euglena - Garza Little Elm Reservoir, Denton County (65, 74)
Monas-like - Garza Little Elm Reservoir, Denton County (74)
Amoeba - Garza Little Elm Reservoir, Denton County (73, 75)

Colpoda sp. - North Texas (75)
Lionotus-like - North Texas (75)
Nuclearia-like - North Texas (75)
Mastigamoeba-like - North Texas (75)

PHYLUM PORIFORA (SPONGES).

Spongilla fragilis - Trinity River, Dallas County (14)
Trochospongilla horrida - Elm Fork, Dallas County (14)
Asteromyenia plumosa - White Rock Lake, Dallas County (14)
Ephydatia crateriformis - East Fork, Dallas County (14)
Spongilla lacustris - Elm Fork, Dallas County (14)
Trochospongilla leidyi - East Fork, Rockwall County (14)
Craspedacusta sowerbii - Texas (62), Dallas County, Garza Little Elm, White Rock Lake (63)

According to Cheatum and Harris (1953) the size and growth differences in sponges in the Trinity River drainage as compared to those of other river systems could probably be explained by the low organic content of the water and its high turbidity of the Trinity.

PHYLUM COELENTERATA

Hawley (65) listed two species of the genus *Hydra* (*H. viridis* and *H. fusca*) occurring in Tarrant County. These poor records are the only citations available concerning this Phylum.

PHYLUM PLATHELMINTHES

Trematoda

Monogenea

Urocleidus sp. - Walker County, Tarrant County (53)
Cleidodiscus pricei - Denton County (67)
Actinocleidus longus - Denton County (67)
*A. fergusoni** - Denton County (67)
*Urocleidus attenuatus** - Denton County (67)
U. principalis - Denton County (67)
Cleidodiscus robustus - Denton County (67)
*Urocleidus grandis** - Denton County (67)
*Urocleidus chrysops** - Denton County (67)
*Dactylogyrus perlus** - Denton County (67)

Aspidobothreans

Cotylaspis insignis - Denton County (24)
Aspidogaster conchicola - Denton County (24)

Digenea

Posthodiplostomum minimum - Madison County (44)
Paramphistomum stunkardi - Tarrant County (53)
Phyllodistomum lohrenzi - Tarrant County (53)
Bucephalus elegans - Denton County (24)
Larval Forms
*Cercaria amblemae*** - Denton County (24)
Strigeid metacercariae - Walker County (53)

Cestoda

Proteocephalus ambloplites - Tarrant County (53), Walker County (53)

Turbellaria

Dalyellia armigera - Tarrant County (65)

All organisms listed above are parasites of fishes or bivalves. The monogenetic trematodes are ectoparasites of fish. *Cercaria amblemae* recorded from Garza Little Elm Reservoir by Flook and Ubelaker (24) is an endemic species. Asterix denotes that the organism is only recorded from this locality in Texas. The free-living turbellarian is a fresh-water form. Unfortunately no locality is given for this organism (65).

PHYLUM ACANTHOCEPHALA

Neoechinohynchus cylindratum - Tarrant County (53), Walker County (53)

Spinyheaded worms are pathogenetic to their fish hosts. This species is reported from black bass in the Tennessee Colony Reservoir.

PHYLUM ASCHELMINTHES

Nematoda

Contracaecum sp. - Walker County (53)
Camallanus sp. - Tarrant County, Walker County (53)

These roundworms are parasites of black bass collected from the Tennessee Colony Reservoir. Hawley (65) reported the nematode *Anguillula acetis* from Texas waters. This report is most certainly erroneous.

Rotatoria (Rotifers)

Brachionus spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifer present only in the month of October from Lake Bridgeport; August from Eagle Mountain Lake; September from Lake Dallas, and January, April, October and December from Lake Worth.

Monostyla spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey reported this rotifer present in January, February and June from Lake Bridgeport; March, May and July through September from Eagle Mountain Lake; only in September from Lake Dallas and August and October from Lake Worth.

Synchaeta spp. - Jack, Wise, Denton Counties (64). Harris and Silvey (64) reported this rotifera present only in October from Lake Bridgeport, only in September from Lake Dallas and only in August from Lake Worth.

Notholca spp. - Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifera present only in February and May from Eagle Mountain Lake, April and May from Lake Dallas and March, June, July, September and December from Lake Worth.

Rattulus spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifera present in the month of October from Lake Bridgeport; June and July from Eagle Mountain Lake; September from Lake Dallas and March and August from Lake Worth.

Pterodina spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifera present in January, March, April, July, October and November from Lake Bridgeport; January through March and September through December from Eagle Mountain Lake; January, August, September and November from Lake Dallas; February through April and October through December from Lake Worth.

Conochilus spp. - Jack,Wise, Tarrant, Denton Counties (64). Harris and Silvey reported this rotifera present in July from Lake Bridgeport; February, June, October and November from Eagle Mountain Lake, September only from Lake Dallas; and January, May, October and November from Lake Worth.

Asplanchina spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifera in January through April and October through November from Lake Bridgeport; January through June, August, September, November and December from Eagle Mountain Lake; January and September from Lake Dallas; January through March, June and July, October through December from Lake Worth.

Tetramastix spp. - Denton County (64). Harris and Silvey (64) reported this rare rotifera present only in October from Lake Worth.

Polyarthra spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this rotifera in February through April, June through October from Lake Bridgeport; January through November from Eagle Mountain Lake; March through April, July through October from Lake Dallas; and in all months in Lake Worth.

PHYLUM ANNELIDA

Diplocardia Sandersi - Dallas and Walker Counties (25)
Limnodrilis sp. - Dallas County
Tubifex tubifex - Dallas County
Nais - Tarrant County (65)

Annelids are not well known in Texas. *Diplocardia Sandersi* is a terrestrial earthworm whereas the remaining species are freshwater.

PHYLUM MOLLUSCA

Bivalves (clams)
Anodonta grandis - Trinity River (57, 46)
Anodonta ohiensis - Trinity River (57)
Arcidens confragosus - Trinity River (57), Houston County (2), Denton County (24)
Strophitus undulatus - Trinity River (57)
Quadrula quadrula apiculata - Trinity River (57, 46)
Q. q. forsheyi - Trinity River (57)
Q. q. aspera - Trinity River (46, 57)
Tritogonia verrucosa - Trinity River (46, 57), Anderson County (2)
Quadrula pustulosa - Trinity River (46, 57)
Q. q. mortoni - Trinity River (57)
Quadrula houstonensis - Trinity River (57)

Quadrula ridelli - Trinity River (57)
Quadrula flava nasuta - Trinity River (57)
Quadrula undata chunis - Trinity River (57, 46)
Amblema plicata costata - Trinity River (57, 46), Denton County (24)
A. p. pesplicata - Trinity River (57, 46), Houston County (2), Denton County (24)
Amblema gigantea - Trinity River (57, 46), Houston County (2), Anderson County (2)
Amblema dombeyana - Trinity River (57, 46), Houston County (2)
Obliquaria reflexa - Trinity River (57, 46)
Lampsilis teres - Trinity River (57, 46), Houston County (2), Anderson County (2)
Lampsilis fasciata hydiana - Trinity River (57, 46), Walker County (2), Anderson County (2), Denton County (24), Houston County (2)
Lampsilis lienosa - Trinity River (57, 46)
Leptodea fragilis - Trinity River (57, 46), Denton County (24)
Proptera purpurata - Trinity River (57, 46), Denton County (24)
Proptera ampichdena - Trinity River (57)
Caruncudina parva texasensis - Trinity River (57, 46)
Truncilla truncata - Trinity River (57, 46)
Truncilla donaciformis - Trinity River (57, 46)
Truncilla macrodon - Trinity River (57, 46)
Strophitus subvexus - Trinity River (46)
Uniomerus tetralasmus - Trinity River (46), Walker County (2)
U. t. manubues - Trinity River (46)
Quadrula nodulata - Trinity River (46)
Quadrula askervi - Trinity River (46), Houston County (2), Anderson County (2)
Lampsilis cardium satura - Trinity River (46), Houston County (2)
Gebula suborbiculata - Trinity River (46)
Anodonta corpulenta - Denton County (24)
Quadrula quadrula - Denton County (24)
Gastropods (snails)
Physa virgata - Trinity River (12)
Helosoma anceps - Trinity River (12)
Helosoma trivolvus lentum - Trinity River (12)
Gyraulus parvus - Trinity River (12)

Ferrissia rivularis - Trinity River (12)
Triodopsis henriettae - Henderson County, Anderson County, Houston County, Polk County (13)
Triodopsis vultuosa - Trinity County, Freestone County, Anderson County, Houston County, Walker County, San Jacinto County (13)
Triodopsis cragini - Walker County (13)
Polygyra texasiana texasiana - Navarro County, Walker County, Polk County (13)
Polygyra leporina - Freestone County, Anderson County, Walker County, San Jacinto County, Trinity County, Polk County (13)
Polygyra dorreuilliana dorfeuilliana - Freestone County, Polk County (13)
Polygyra mooreana - Anderson County, Polk County (13)
Polygyra septemvolva volvovis - Houston County (13)
Praticolella berlandieriana berlandieriana - Anderson County (13)
Praticolella pachyloma - Anderson County, Houston County, San Jacinto County, Polk County (13)
Mesodon thyroidus thyroidus - Polk County, Anderson County, Houston County, Walker County, San Jacinto County, Trinity County (13)
Stenotrema leai aliciae - Anderson County, San Jacinto County, Polk County (13)

Both snail and class are well represented in the Tennessee Colony Reservoir. At least 33 species of mollusks have been recorded. This extensive list includes no endemic species. The mollusks reported from the Big Thicket are not included in this section. The fauna and flora of the Big Thicket area by Parks and Cory (1938) adds additional representative species to this list.

PHYLUM ARTHROPODA

Class Arachnida

Unionicola sp. (mites) - Denton County (24)
Amblyomma americanum (ticks) - Henderson County, Navarro County, Leon County, Houston County, San Jacinto County, Walker County (20)
Dermacentor vanabilis - Navarro County (20)

Haemaphysalis leporis-palustris - Navarro County (20)
Ixodes cookei - Freestone County, Walker County (20)
Ixodes scapularis - Walker County, Henderson County (20)
Ixodes texanus - Freestone County (20)

At least seven ticks have been reported from the Tennessee Colony Reservoir. They are important seasonally as pests and transmitters of disease (see part 3 of this report).

Class Arachnida

Centruroides vittatus - Tarrant County (69)
Araneus frondosa - Tarrant County (69)
Aranea sp. - Tarrant County (69)
Loxosceles refescens - Tarrant County (69)
Pirata insularis - Tarrant County (69)
Latrodectus mactans - Tarrant County (69)
Mimetus interfector - Tarrant County (69)
Phidippus andax - Tarrant County (69)

These scorpions (*Centruroides*) and spiders are all riparian species and occurred beside a sewage filter bed at the Fort Worth Sewage treatment.

Class Diplopoda

Aniulus fluviatilis - Polk County (11)
Hakiulus minori - Polk County (11)

The two species of millipeds recorded from the Tennessee Colony Reservoir are terrestrial organisms.

Class Crustacea

Isopoda (sowbugs)
Porcellionides Virgatus - San Jacinto County (1)
Armadillidium Vulgare - San Jacinto County, Walker County (1), Tarrant County (69)
Metoponorthus pruinosus - Tarrant County (69)

These organisms are terrestial isopods requiring moist habitats.

Decapoda (crabs, crayfish)

<u>Cambarus blandingii acutus</u> - San Jacinto County (47), Polk County (47, 49), Walker County (49), Madison County (49)

<u>Cambarus hedgepethi</u> - San Jacinto County, Walker County (49)

<u>Procambarus clarki</u> - Polk County, San Jacinto County (49)

<u>Procambarus dupratzi</u> - Anderson County (48, 49)

<u>Procambarus simulans</u> - Polk County, San Jacinto County (49)

<u>Cambarellus puer</u> - San Jacinto County (49)

<u>Orconectes palmeri</u> - San Jacinto County (49)

<u>Macrobrachium ohione</u> - Trinity River, Anderson County (28)

The crayfish are widely distributed organisms. <u>Macrobrachium ohione</u> is a freshwater river shrimp.

Copepoda

<u>Cyclops</u> spp. - Jack,Wise, Tarrant, Denton Counties (64, 66). Harris and Silvey (64) reported this common copepod (water flea) present in Lake Bridgeport during the months of January, March, May through September; from Eagle Mountain Lake in January, March through May and July through December; in Lake Dallas from January through September and November and December; and, in Lake Worth from February through April and July through December. Rose (66) reported <u>Cyclops</u> from Tarrant County.

<u>Canthocamptus</u> spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this copepod from Lake Bridgeport in February through April and December, from January through April, September, November and December; from Lake Dallas in September and from Lake Worth in March, April and October.

<u>Diaptomus</u> spp. - Jack, Wise, Tarrant Counties (64). Harris and Silvey (64) reported this copepod from Lake Bridgeport in February through April, August, September and November; from Eagle Mountain Lake in January, March, May through December; from Lake Worth in March through August and October through December.

Cladocera (waterfleas)

Diaphanosoma spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this genus from Lake Bridgeport in January, February and July; from Eagle Mountain Lake in May, August, September and November; from Lake Dallas in March, October and November; from Lake Worth in July and October.

Polyphemus spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this genus from Lake Bridgeport in February, April, May, September and November; from Eagle Mountain Lake in January through March, May and December; from Lake Dallas in September; and from Lake Worth in January, March, July, August, November and December.

Daphnia spp. - Jack, Wise, Tarrant, Denton Counties (64, 68). Harris and Silvey (64) reported this genus from Lake Bridgeport in February through September and November; from Eagle Mountain Lake in January through August, October through December; Lake Dallas in March through December and from Lake Worth in January through March, June, August through December. Brooks (68) reported D. pulex and D. obtusa common in pools and lakes in these counties. In addition, she reported D. arcuata from Arlington, Texas (6 mi. N.E.).

Bosmina spp. - Jack, Wise, Tarrant, Denton Counties (64). Harris and Silvey (64) reported this genus from Lake Bridgeport in February through April and November; Eagle Mountain Lake in January through September and November, December; from Lake Dallas in March through May, August and November; Lake Worth in January through May and July through December.

Pleuroxus hamulatus - Tarrant, Parker, Wise Counties, Lake Worth (68)

P. aduncus - Tarrant, Parker, Wise Counties, Lake Worth (68)

P. denticulatus - Tarrant, Parker, Wise Counties, Lake Worth (68)

Chydorus sphaericus - Tarrant County (below Lake Worth dam) (68)

Chydorus globosus - Tarrant County (below Lake Worth dam) (68)

Alonella diaphana - Dallas County (10 mi. W. Dallas) (68)
Alona costata - Tarrant, Dallas Counties (68)
Moina rectirostris - Denton, Tarrant Counties (68)
M. paradoxa - Denton, Tarrant Counties (68)
Ceriodaphnia pulchella - Tarrant County (68)
Ceriodaphnia Laticaudata - Tarrant County (68)
Scapholeberis mucronata - All north Texas (68)
Simocephalus vetulus - All north Texas (68)
Simocephalus exspinosus - Tarrant County (68)
Simocephalus serrulatus - Tarrant, Denton Counties (68)
Macrothrix laticornis-laticornis - Denton County (68)
Macrothrix borysthenica - Dallas County (68)
Macrothrix rosea - Denton County (68)

Becker and Sissom (1971) have recently summarized the Cladoceran fauna of Texas. As these authors point out the Cladocera "are an important link in the food chain of any body of fresh water. Planktonic Cladocera occur in all kinds of freshwater habitats including rivers, lakes, and temporary ponds. While some species reproduce sexually, many have remarkable parthenogenetic capabilities and are able to produce large populations very quickly in order to take advantage of the most favorable environmental conditions".

Class Insecta

Gemphus militaris - Anderson County (27)
Macromia taeniolata - Anderson County (27)
Perithemis tenera - Anderson County (23, 27)
Orthemis ferruginia - Anderson County (27)
Libellula luctuosa - Anderson County (27)
Libellula cyanea - Anderson County (23, 27)
Libellula incesta - Anderson County (27)
Libellula vibrans - Anderson County (27)
Plathemis lydia - Anderson County (27)
Pachydiplax pongipennis - Anderson County (27)
Erythemis simplicicallis - Anderson County (27)
Agrion maculatum - Anderson County (23, 27)
Argia tibialis - Anderson County (27)
Argia moesta - Anderson County (27)
Ischnura posita - Anderson County (27)
Tachopteryx thoreyi - Anderson County (23)
Enallogma signatum - Anderson County (23)

Celithemis fasciatus - Anderson County (23)
Argia tibialis - Henderson County (23)
Epitrix fuscula - Anderson County (7)
Epitrix sp. - Anderson County (7)
Diabrotica undecimpunctata howardi - Anderson County (7)
Cercopeus bolli - Anderson County (8)
Lixellus haldemani - Anderson County (8)
Pnigodes belfragi - Anderson County (8)
Pnigodes buchanani - Anderson County (8)
Listronotus ingens - Anderson County (6)
Listronotus distinctus - Anderson County (6)
Listronotus rotundicollis - Anderson County (6)
Listronotus nebulosus - Anderson County (6)
Nanophyes vesperus - Anderson County (5)
Endalus depressus - Anderson County (5)
Cryptocephalus albicans - Anderson County (58)
Cryptocephalus notatus sellatus - Anderson County (58)
Cryptocyphalus ochraceus - Anderson County (58)
Cryptocyphalus quadruplex - Anderson County (58)
Leptopsylla signis - Henderson County, Houston County (19)
Nosopsyllus fasciatus - Henderson County, Houston County, Madison County (19)
Orchopeas howardii - Anderson County, Freestone County (19)
Cediopsylla simplex - Navarro County (19)
Ctenocephalides felis - statewide (19)
Echidnophaga gallinaces - statewide (19)
Pulex irritans - statewide (19)
Xenopsylla cheopis - statewide (19)
Musca domestica - Tarrant County (69)
Stomoxys calcitrans - Tarrant County (69)
Dynastes uityus - Tarrant County (69)
Psychoda alternata - Tarrant County (69)
Psychoda albipunctata - Tarrant County (69)
Gyretes sinuatus - Denton Creek, Dallas County (70)
Gyrinus parcus - Bachman Spillway, Ten Mile Creek, Dallas County (70)
Dineutus/americanus - White Rock Creek, Denton Creek, Carrollton Dam, Dallas County, Denton County (70)
Haliplus punctatus - White Rock Creek at Springs Road (70)
Hiliplus fasciatus - no locality (70)

Peltodytes litoralis - Denton Creek, Bachman Creek, White Rock Creek, Carrollton Dam, Dallas County (70)

Peltodytes pedunculatus - Bachman Creek, Dallas County (70)

Berosus peregrinus - Carrollton Dam, Ten Mile Creek, Bachman Creek at Northwest Highway and at Walnut Hill Lane, White Rock Lake and White Rock Creek, Dallas County (70)

Berosus infuscatus - Trinity River Floodplains, Dallas County (70)

Enochrus hebulosus - Bachman Spillway, Five Mile Creek, Bachman Creek, White Rock Creek, Dallas County (70)

Tropisternus lateralis - Denton Creek, Trinity River, White Rock Lake and White Rock Creek, Dallas County (70)

Hydrophilus triangularis - no locality, Dallas County (70)

Laccophilus fasciatus - Bachman Creek, White Rock Lake (70)

Laccophilus confusus - Bachman Spillway, Carrollton Dam, Dallas County

Laccophilus proximus - Ten Mile Creek, Bachman Creek, Dallas County (70)

Hydroporus dimidiatus - White Rock Creek, Bachman Lake, Ten Mile Creek, Dallas County (70)

Hydroporus diversicornis - White Rock Creek, Dallas County (70)

Bidessus pulicarius - Trinity River Floodplains, Five Mile Creek, Ten Mile Creek, White Rock Creek, Dallas County (70)

Bidessus affinis - Trinity River Floodplains, White Rock Creek, Dallas County (72)

Thermonectus ornaticollis - Trinity River Floodplains, Carrollton Dam, Trinity River, Dallas County (70)

Perlesta placida - Denton County (71, 73)

Chaoborus punctipennis - Garza Little Elm Reservoir, Denton (72)

Tendipes sp. - Garza Little Elm Reservoir, Denton (72)

Bittacomorpha clavipes - Garza Little Elm Reservoir, Denton (72)

Tipula triplex - Garza Little Elm Reservoir, Denton (72)

Trichorixa reticulata - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Ramphocorixa acuminata - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Sigara alernata - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Buenoa Scimitra - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Saldula pallipes - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Cyrnellus fraternus - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Hydropsyche orris - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Cheumatopsyche campyla - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Triaenodes injusla - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Vecetis inconspicua - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Leptocella candida - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Isonychia sp. - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Caenis sp. - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Corydalus cornutus - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Chauliodes sp. - Garza Little Elm Reservoir, Clear Creek, Denton Creek, Denton County (73)

Aedes nigromaculis - Denton County, Texas (74)

Aedes sollicitans - Denton County, Texas (74)

Aedes vexans - Denton County, Texas (74)

Aedes (Ochlerotatus) sp. - Denton County, Texas (74)

Anopheses sp. - Denton County, Texas (74)

A. quadrimaculatus - Denton County, Texas (74)

Culex tarsalis - Denton County, Texas (74)

Culex pipiens quinquefasciatus - Denton County, Texas (74)

Psorophora ciliata - Denton County, Texas (74)

Tabanus abactor - Denton County, Texas (74)

Hybomitra lasiophthalma - Denton County, Texas (74)

Tabanus atratus - Denton County, Texas (74)

Tabanus similis - Denton County, Texas (74)

Tabanus sulcifrons - Denton County, Texas (74)
Hexagenis sp. - Lake Texoma (75)
Celithemis eponina - Lake Texoma (75)
Dythemis velox - Lake Texoma (75)
Erythemis simplicicollis - Lake Texoma (75)
Gomphus externus - Lake Texoma (75)
Gomphus militaris - Lake Texoma (75)
Lepthemis sp. - Lake Texoma (75)
Libellula luctuosa - Lake Texoma (75)
Pachydiplax logipennis - Lake Texoma (75)
Perithemis tenera - Lake Texoma (75)
Plathemis lydia - Lake Texoma (75)
Tarnetrum corruptum - Lake Texoma (75)
Tramea lacerata - Lake Texoma (75)
Agrion maculatum - Lake Texoma (75)
Argia apicalis - Lake Texoma (75)
Argia immunda - Lake Texoma (75)
Argia moestra - Lake Texoma (75)
Argia nahuana - Lake Texoma (75)
Argia violacia - Lake Texoma (75)
Enallagma basidens - Lake Texoma (75)
Enallagma civile - Lake Texoma (75)
Hetaerina americana - Lake Texoma (75)
Telebasis salva - Lake Texoma (75)
Gelastocoris - Lake Texoma (75)
Polycepntropus sp. - Lake Texoma (75)
Tendipes - Lake Texoma (75)

The number of species of freshwater insects is considerable. A majority are known from the Tennessee Colony Reservoir. These forms, which include dragonflies and damseflies are represented in the Tennessee Colony Reservoir as larval stages.

All Coleoptera that have been reported are terrestrial. Fleas represents ectoparasites of terrestrial animals.

PHYLUM CHORDATA

Lamb (76) reported the following fish from the Trinity River watershed.

Lepisosteus spatula (Alligator gar)
Lepisosteus platostomus (Shortnose gar)

Lepisosteus productus (Spotted gar)
Lepisosteus osseus (Longnose gar)
Amia calva (Bowfin)
Brevoortia gunteri (Menhaden)
Dorosoma cepedianum (Gizzard shad)
Astyanax fasciatus (Banded tetra)
Ictiobus bubalus (Smallmouth buffalo)
Carpiodes carpio (River carpsucker)
Moxostoma congestum (Grey redhorse)
Minytrema melanops (Spotted sucker)
Erimyzon sucetta (Chubsucker)
Cyprinus carpio (Carp)
Notemigonus crysoleucas (Golden shiner)
Phenacobius mirabilis (Suckermouth minnow)
Notropis fumeus (Ribbon shiner)
Notropis umbratalis (Redfin shiner)
Notropis brazosensis (Brazos River shiner)
Notropis venustus (Blacktail shiner)
Notropis lutrensis (Red shiner)
Notropis deliciosus (Sand shiner)
Notropis atrocaudalis (Blackspot shiner)
Hybognathus nuchalis (Silvery minnow)
Hybognathus placita (Plains minnow)
Pimephales vigilax (Parrot minnow)
Pimephales promelas (Fathead minnow)
Campostoma anomalum (Stoneroller)
Ictalurus punctatus (Channel catfish)
Ictalurus furcatus (Blue catfish)
Ictalurus melas (Black bullhead)
Ictalurus natalis (Yellow bullhead)
Pylodictus olivaris (Flathead catfish)
Schilbeodes gyrinus (Tadpole madtom)
Fundulus notatus (Blackstripe topminnow)
Fundulus olivaceus (Blackspot topminnow)
Gambusia affinis (Mosquitofish)
Mugil cephalus (Striped mullet)
Roccus chrysops (White bass)
Roccus mississippiensis (Yellow bass)
Mictopterus punctulatus (Spotted bass)
Micropterus salmoides (Largemouth bass)
Chaenobryttus gulosus (Warmouth)
Lepomis cyanellus (Green sunfish)
Lepomis symmetricus (Small sunfish)
Lepomis punctatus (Spotted sunfish)

Lepomis microlophus (Redear sunfish)
Lepomis macrochirus (Bluegill sunfish)
Lepomis humilis (Orange spotted sunfish)
Lepomis auritus (Yellowbelly sunfish)
Lepomis megalotis (Longear sunfish)
Pomoxis annularis (White crappie)
Centrarchus macropterus (Flier sunfish)
Hadropterus scierus (Dusky darter)
Percina caprodes (Logperch)
Ethoestoma chlorosomum (Bluntnose darter)
Aplodinotus grunniens (Freshwater drum)

Additional records are listed below.

Phenacobius mirabilis - Trinity River, Anderson County (31)
Ichthyomyzon gagei - Trinity River (29)
Etheostoma asprigene - Trinity River (29)
Noturus nocturnus - Trinity River (22)
Leptops olivaris - Trinity River (22)
Ameiurus melas - Trinity River (22)
Ictalurus punctatus - Trinity River (22)
Ictalurus furcatus - Trinity River (22)
Ictiobus bubalus - Trinity River (22)
Carpiodes carpio - Trinity River (22)
Manytrema melanops - Trinity River (22)
Campostoma anomalum - Trinity River (22)
Hybognathus nuchalis - Trinity River (22)
Cochlognathus ornatus - Trinity River (22)
Cliola vigilax - Trinity River (22)
Notropis nux - Trinity River (22)
Notropis nocomis - Trinity River (22)
Notropis lutrensis - Trinity River (22)
Notropis venustus - Trinity River (22)
Notropis dilectus - Trinity River (22)
Opsopoeodus oscula - Trinity River (22)
Notemigonus chrysoleucus - Trinity River (22)
Dorosoma cepedianum - Trinity River (22)
Zygonectes notatus - Trinity River (22)
Zygonectes escambiae - Trinity River (22)
Gambusia affinis - Trinity River (22)
Lucius vermiculatus - Trinity River (22)
Labidesthe sicculus - Trinity River (22)
Pomoxis annularis - Trinity River (22)

Chaenobryttus gulosus - Trinity River (22)
Lepomis cyanellus - Trinity River (22)
Lepomis meyalotis - Trinity River (22)
Lepomis humilis - Trinity River (22)
Lepomis pallidus - Trinity River (22)
Micropterus salmoides - Trinity River (22)
Etheostoma phlox - Trinity River (22)
Etheostoma caprodes - Trinity River (22)
Etheostoma scierum serrula - Trinity River (22)
Etheostoma fusiforme - Trinity River (22)
Morone interrupta - Trinity River (22)
Aplodinotus grunniens - Trinity River (22)

Class Amphibia

Ambystoma opacum - Post Oak Belt, Pine Belt (4)
Ambystoma texanum - Post Oak Belt (4), Henderson County (10), Pine Belt (4)
Ambystoma microstomum - Henderson County (56)
Ambystoma maculatum - Pine Belt (4)
Ambystoma tigrinum - Post Oak Belt (4), Henderson County (10), Pine Belt (4)
Diemictylus viridescens louisianensis - Post Oak Belt (4), Anderson County (52), Pine Belt (4)
Triturus viridescens viridescena - Anderson County (10)
Manculus quadridigitatus paludicolus - Post Oak Belt (4), Henderson County, Anderson County (52), Pine Belt (4)
Eurycea quadridigitata quadridigitata - Anderson County (10)
Siren intermedia nettingi - Post Oak Belt, Pine Belt (4)
Siren lacertina - Henderson County (10, 56), Leon County (10)
Necturus beyeri - Pine Belt (4)
Amphiuma tridactylum - Pine Belt (4)
Desmognathus fuscus brimleyorum - Pine Belt (4)
D. f. auriculatus + D. f. brimleyorum - Polk County, San Jacinto County (37)
Bufo woodhousii fowleri - Pine Belt, Post Oak Belt (4), Henderson County (56)
B. w. woodhousii - Post Oak Belt (4)
Bufo compactilis speciosus - Post Oak Belt (4)
Bufo valliceps valliceps - Post Oak Belt (4), Henderson County (56)

Acris crepitans - Pine Belt, Post Oak Belt (4)
Acris gryllus - Henderson County (56)
Scaphiopus hurterii - Post Oak Belt (4), Walker County (52)
Hyla cinerea cinerea - Post Oak Belt (4), Henderson County (52, 56), Pine Belt (4), Anderson County (52)
Hyla versicolor chrysoscelis - Anderson County (52), Henderson County (52, 56), Pine Belt, Post Oak Belt (4)
Hyla crucifer crucifer - Pine Belt (4)
Microhyld carolinensis carolinensis - Henderson County (52, 56), Post Oak Belt, Pine Belt (4)
Pseudacris clarkii - Post Oak Belt (4)
Pseudacris nigrita tnseriata - Pine Belt, Post Oak Belt (4), Henderson County (52), Walker County (38)
Pseudacris streckeri - Post Oak Belt (4)
Rana catesbiana - Post Oak Belt, Pine Belt (4), Henderson County (56)
Rana clamitans - Anderson County (56), Post Oak Belt, Pine Belt (4)
Rana grylio - Pine Belt (4)
Rana palustris - Post Oak Belt, Pine Belt (4), Anderson County (52)
Rana pipiens berlandieri - Pine Belt, Post Oak Belt (4)
Rana pipiens - Henderson County (56)
Microhyla olivacea - Post Oak Belt (4)
Rana sphenocephala - Henderson County (56)

Class Reptilia

Anolis carolinensis - Pine Belt, Post Oak Belt (4), Henderson County (56)
Sceloporus undulatus pryacinthinus - Pine Belt, Post Oak Belt (4), Henderson County (52)
Sceloporus undulatus - Henderson County (56)
Sceloporus olivaceus - Post Oak Belt (4)
Holbrookia maculata lacerta - Post Oak Belt (4)
Phrynosoma cornutum - Post Oak Belt (4)
Eumeces brevilineatus - Post Oak Belt (4)
Eumeces fasciatus - Pine Belt (4), Henderson County (56), Post Oak Belt (4)
Eumeces laticeps - Post Oak Belt (4)
Eumeces septentrionalis obtusirostris - Leon County (52), Post Oak Belt (4)

Leiolopisma laterale - Post Oak Belt, Pine Belt (4), Henderson County (56)
Cnemidophorus gularis gularis - Post Oak Belt (4), Henderson County (56)
Cnemidophorus sexlineatus - Pine Belt, Post Oak Belt (4), Henderson County (56)
Ophisaurus ventralis - Post Oak Belt, Pine Belt (4)
Elaphe obsaleta lindheimeri - Polk County
Elaphe obsoleta confinis - Pine Belt, Post Oak Belt (4), Henderson County (56)
Elaphe laeta laeta - Post Oak Belt (4)
Leptotyphlops dulcis - Post Oak Belt (4)
Coluber constrictor - Post Oak Belt (4)
Coluber constrictor flaviventris - Henderson County (56)
Farancia abacura reinwardtii - Post Oak Belt, Pine Belt (4), Henderson County (56)
Haldea striatula - Pine Belt, Post Oak Belt (4), Henderson County (56)
Heterodon contortrix contortrix - Pine Belt, Post Oak Belt (4), Henderson County (56)
Heterodon platyrhinos - Polk County
Lampropeltis getulus holbrooki - Pine Belt, Post Oak Belt (4)
Haldea vuleriae elegans - Post Oak Belt (4)
Lampropeltis triangulum amauoa - Pine Belt, Post Oak Belt (4)
Heterodon nasicus nasicus - Post Oak Belt (4)
Hypsiglena ochrortrynchus texana - Post Oak Belt (4)
Masticophis flagellum flagellum - Post Oak Belt, Pine Belt (4)
M. f. testaceus - Post Oak Belt (4)
Opheodrys aestivus - Pine Belt, Post Oak Belt (4), Henderson County (56), Polk County
Tantilla gracilis - Pine Belt, Post Oak Belt (4)
Natrix erythrogaster erythrogaster - Post Oak Belt, Pine Belt (4), Henderson County (56)
Natrix grahamii - Post Oak Belt (4)
Natrix sipedon confluens - Post Oak Belt, Pine Belt (4), Polk County (32)
Natrix sipedon transersa - Henderson County (56)
Natrix rigida - Pine Belt (4), Henderson County (17) Leon County (17)
Storeria dekayi texana - Pine Belt, Post Oak Belt (4), Henderson County (52, 56), Anderson County (52)

Thamnophis sauritus proximus - Pine Belt, Post Oak Belt (4), Henderson County (56), Polk County (32)
Thamnophis marciana - Post Oak Belt (4)
Thamnophis sirtalis annectans - Post Oak Belt (4)
Tropidoclonion lineatum - Post Oak Belt (4)
Mierurus fulvius tenere - Post Oak Belt, Pine Belt (4), Polk County (32)
Agkistrodon contortrix - Polk County
Agkistrodon piscivorus leucostoma - Pine Belt, Post Oak Belt (4)
Agkistrodon piscivorus - Henderson County (56)
Agkistrodon mokeson mokeson - Post Oak Belt (4), Henderson County (56)
Agkistrodon mokeson austrinus - Post Oak Belt, Pine Belt (4)
Crotalus atrox - Post Oak Belt (4)
Crotalus horridus atricaudatus - Post Oak Belt (4), Polk County (32)
Crotalus horridus - Henderson County (56)
Sistrurus catenatus tergeminus - Post Oak Belt (4)
Sistrurus miliarius streckeri - Post Oak Belt, Pine Belt (4), Polk County (32)
Sistrurus miliarius - Henderson County (56)
Kinosternon flavescens flavescens - Post Oak Belt (4)
Kinosternon subrubrum hippocrepis - Pine Belt (4)
Sternotherus carinatus - Pine Belt, Post Oak Belt (4), Henderson County (56)
Sternotherus odoratus - Pine Belt, Post Oak Belt (4)
Chelydra serpentina serpentina - Post Oak Belt, Pine Belt (4), Henderson County (56)
Deirochelys reticularia - Post Oak Belt, Pine Belt (4)
Graptemys pseudogeographica pseudogeographica - Post Oak Belt (4)
G. p. kohnii - Pine Belt, Post Oak Belt (4)
G. p. oculifera - Henderson County (56)
Pseudemys floridana hoyi - Pine Belt, Post Oak Belt (4)
P. f. texana - Post Oak Belt (4)
Pseudemys scripta elegans - Pine Belt, Post Oak Belt (4), Henderson County (56)
Terrepene carolina triunguis - Pine Belt, Post Oak Belt (4), Henderson County (56)
Amyda emoryi - Pine Belt (4), Henderson County (56)
Amyda mutica - Pine Belt (4)
Macrochelys temminckii - Pine Belt (4), Henderson County (56)

Pseudemys trosti - Henderson County (56)
Alligator mississippiensis - Pine Belt, Post Oak Belt (4), Henderson County (56)

Class Aves (All records from reference 45)

Nyctanassa violacea - Eastern Riparian Association
Nycticorax nycticorax naevious - Eastern Riparian Association
Butorides virescens virescens - Eastern Riparian Association
Florida caerulea caerulea - Eastern Riparian Association
Hydranassa tricolor ruficallis - Eastern Riparian Association
Leucophoyx thula thula - Eastern Riparian Association
Casmerodius alba egretta - Eastern Riparian Association
Ardea herodias wardi - Eastern Riparian Association
Mycteria americana - Eastern Riparian Association
Aix sponsa - Eastern Riparian Association
Coragys urubu urubu - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Cathartes aura septentrionalis - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Cerchneis sparveria sparveria - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Buteo borealis borealis - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Buteo lineatus alleni - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Buteo platypterus platypterus - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Haliaeetus leucocephalus leucocyhalus - Eastern Riparian Association
Accipiter cooperii - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Accipiter velox - Eastern Riparian Association, Eastern Oak, Eastern Brush
Circus cyaneus hudsonius
Ictinia mississippiensis - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Elanoides forficatus forficatus - Eastern Riparian Association

Meleagris gallopaxo silvestris - Eastern Riparian Association, Eastern Pine, Eastern Oak, Eastern Brush
Colinus virginianus virginianus - Eastern Riparian Association, Eastern Pine, Eastern Brush
Fulica americana - Eastern Riparian Association
Gallimula chlorapus cachinnans - Eastern Riparian
Actitis macularia - Eastern Riparian
Rubicola minor - Eastern Riparian
Sternula albifrano antillarum - Eastern Riparian
Zenaidura macroura marginella - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Coccyzus americanus americanus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Colaptes auratus auratus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Centurus carolinus - Eastern Riparian, Eastern Pine
Melanerpes erythrocephalus erythrocephalus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Phloeotomus pileatus pileatus - Eastern Riparian, Eastern Pine, Eastern Oak
Phrenopicus borealis - Eastern Riparian, Eastern Pine, Eastern Oak
Dryobates pubescens pubescens - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Dryobates villosus audubonii - Eastern Riparian, Eastern Pine, Eastern Oak
Myarchus crinitus crinitus - Eastern Riparian
Tyrannus tyrannus tyrannus - Eastern Riparian, Eastern Oak, Eastern Brush
Mimus polyglottos polyglottos - Eastern Riparian, Eastern Oak, Eastern Brush
Dumetella canolinensio - Eastern Riparian
Sialia sialis sialis - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Hylocichla mustelina - Eastern Riparian, Eastern Oak
Polioptila cerulea cerulea - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Thryotherus ludovicianus ludovicianus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Sitta pusilla - Eastern Riparian, Eastern Pine, Eastern Oak
Sitta carolinensis carolinensis (=aikeni) - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Cyanocitta cristata cristata (=florincola) - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush

Corvus brachyohynchos paulus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush

Vireo bellii bellii - Eastern Riparian, Eastern Oak, Eastern Brush

Vireo griseus griseus - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush

Lanivreo flavifrons - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush

Vireosylva olivacea - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush

Stelgidopteryx serripennis serripennis

Progne subis subis - Eastern Riparian, Eastern Brush

Setophaga ruticolla - Eastern Riparian, Eastern Pine, Eastern Oak

Wilsonia citrina

Icteria virens virens - Eastern Riparian, Eastern Oak, Eastern Brush

Geothlypis trichas trichas - Eastern Riparian, Eastern Brush

Opornis formosus

Seiurus motacilla

Dendroica dominica albilora - Eastern Riparian, Eastern Oak

Dendroica cerulea

Compsothlypis americana ramalinae - Eastern Riparian, Eastern Oak

Protomotaria citrea

Helmitheros vermivorus

Limothlypis swainsonii

Mniotilta varia - Eastern Riparian, Eastern Pine, Eastern Oak

Agelaius phoeniceus phoeniceus (=floridanus)

Agelaius phoeniceus predatorius

Icterus galbula - Eastern Riparian, Eastern Brush

Campephius principalis

Streptoceryle alcyon alcyon

Bubo virginianus virginianus - Eastern Riparian, Eastern Pine, Eastern Oak

Otus asio asio (=floridanus) - Eastern Riparian, Eastern Pine, Eastern Oak

Strix varia alleni - Eastern Riparian, Eastern Pine, Eastern Oak

Antrostomus carolinensis - Eastern Riparian, Eastern Pine, Eastern Oak

Archilochus colubris - Eastern Riparian, Eastern Pine, Eastern Oak
Chaetura pelagica - Eastern Riparian, Eastern Pine, Eastern Oak
Horizopus virens - Eastern Riparian, Eastern Pine, Eastern Oak
Empidonax virescens - Eastern Riparian
Icterus spurius - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Megaquiscalus major major - Eastern Riparian
Quiscalus quiscalus aeneus - Eastern Riparian, Eastern Brush
Molothrus ater ater - Eastern Riparian, Eastern Brush
Piranga rubra rubra - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Richmondina cardinalis magnirostris - Eastern Riparian, Eastern Pine, Eastern Oak, Eastern Brush
Guiraca cuerulea caerulea - Eastern Riparian, Eastern Brush
Passerina ciris ciris - Eastern Riparian, Eastern Oak, Eastern Brush
Passerina cyanea - Eastern Riparian, Eastern Oak, Eastern Brush
Penthestes carolinensis carolinensis - Eastern Pine, Eastern Oak
Chordeiles minor chapmani - Eastern Pine, Eastern Brush
Myiarchus crinitus crinitus - Eastern Pine, Eastern Oak
Corvus brachyrhynchos brachyrhychos - Eastern Pine, Eastern Oak, Eastern Brush
Dendroica pinus pinus - Eastern Oak, Eastern Pine
Spizella passerina passerina - Eastern Pine, Eastern Brush
Peucaea aestivalis illinoensis - Eastern Pine, Eastern Oak, Eastern Brush
Astragalinus tristis tristis - Eastern Pine, Eastern Oak, Eastern Brush
Geococcyx californianus - Eastern Oak, Eastern Brush
Dryobates villosus villosus - Eastern Oak, Eastern Brush
Thryomanes bewickii cryptus - Eastern Oak, Eastern Brush

Baelophus bicolor - Eastern Oak, Eastern Brush, Eastern Riparian, Eastern Pine
Empidonax traillii brewsteri - Eastern Oak, Eastern Brush
Empidonax minimus - Eastern Oak, Eastern Brush
Passerina ciris pallidior - Eastern Oak, Eastern Brush
Spizella pusilla pusilla - Eastern Oak, Eastern Brush
Chondestes gramacus strigatus - Eastern Oak, Eastern Brush
Polyborus cheriway auduboni - Eastern Brush
Chordeiles minor howelli - Eastern Brush
Hirundo rustica erythrogastris - Eastern Brush
Dendroica discolor - Eastern Brush
Dendroica aestivus aestivus - Eastern Brush
Muscivora forticata - Eastern Brush
Dumetella carolinensis - Eastern Brush
Spiza americana - Eastern Brush
Passer domesticus domesticus - Eastern Brush

Class Mammalia

Didelphis marsupialis (opossum) - Anderson County, Trinity County, Walker County (18)
Scalopus aquaticus (moles) - Anderson County, Houston County, Trinity County, Leon County, Walker County (18)
Blarina brevicauda (shrew) - San Jacinto County, Henderson County (18)
Cryptotis parva (shrew) - Walker County, Navarro County (18)
Pipistrellus subflavus (bat) - Anderson County, Polk County, Walker County (18)
Eptesicus fuscus (bat) - Trinity County, Walker County (18)
Lasiurus borealis (bat) - Trinity County, Walker County (18)
Lasiurus seminolus (bat) - Polk County (18)
Nycticeius humeralis (bat) - Trinity County (18)
Dasypterus floridanus (bat) - Deep East Texas (18)
Tadarida cynocephala (bat) - Anderson County (18)
Procyon loter (raccoon) - Statewide, Henderson County, Polk County (18)

Urocyon cinereoargenteus (raccoon) - Statewide, Trinity County, Polk County, Walker County (18)

Bassaricus astutus - Henderson County (18)

Mustela vison (mink) - Houston County, Polk County (18)

Lutra canadensis - Polk County (18)

Spilogale putorius (skunk) - Walker County (18)

Mephitis mephitis (skunk) - Statewide, Walker County (18)

Conepatus mesoleucus - San Jacinto County (18), almost extinct in Eastern Texas (42)

Canis latrans (coyote) - Statewide, rare in eastern woodlands (18)

Canis niger (R. wolf) - Central and Eastern Texas, Polk County (18), almost extinct in East Texas (42)

Felis concolor (cougar) - Rare in Eastern Texas (18, 42)

Lynx rufus (lynx) - Statewide, Houston County, Walker County, Polk County (18)

Citellus tridecemlineatus (ground squirrel) - Navarro County (18)

Sciurus carolinensis (red squirrel) - Eastern Texas, Anderson County, Polk County, Trinity County, Houston County (18)

Aciurus niger (squirrel) - Central and Eastern Texas, Henderson County, Leon County, Walker County, Trinity County, Polk County (18)

Glaucomys volans (flying squirrel) - Eastern Texas, Trinity County, Henderson County (18)

Geomys bursarius (pocket gopher) - Henderson County, Anderson County, Polk County, Houston County, Trinity County, Walker County, Leon County (18)

Perognathus hispidus (mouse) - Statewide, Trinity County, Walker County (18)

Castor canadensis (beaver) - Rare in East Texas (18)

Reithrodontomys fulvescens (harvest mouse) - Henderson County, Anderson County, Leon County, Trinity County, Walker County (18)

Baiomys taylori (mouse) - Walker County (18)

Peromyscus maniculatus (mouse) - Navarro County, East Texas (18)

Peromyscus leucopus (mouse) - Statewide, Henderson County, Anderson County, Leon County, Trinity County, Polk County, Walker County (18)

Peromyscus nuttalli (mouse) - Anderson County (41, 43)

Peromyscus gossypinus meyacephalus (mouse) - Henderson County, Anderson County (43)

Peromyscus gossypinus (mouse) - East Texas, Leon County, Walker County, San Jacinto County, Polk County, Anderson County, Henderson County, Houston County (39)

Oryzomys palustris (rice rat) - Eastern and Coastal Texas, Trinity County, Walker County (18)

Sigmodon hispidus (cotton rat) - Statewide, Henderson County, Anderson County, Trinity County, Walker County (18)

Neotoma floridana (woodrat) - Eastern Texas, Polk County, Walker County, Trinity County, Henderson County (18)

Ondatra zibethicus (muskrat) - Trinity County (18)

Mus musculus (house mouse) - Statewide (18)

Rattus rattus (rat) - Statewide (18)

Rattus norvegicus (rat) - Statewide (18)

Myocastor coypus (nutria) - Widespread, all counties in survey have reports of nutria (18)

Lepus californicus (jackrabbit) - Statewide, Houston County, Walker County (18)

Sylvilagus floridanus (cottontail) - Statewide, Navarro County, Walker County (18)

Sylvilagus aquaticus (aquatic rabbit) - Eastern Texas, Anderson County, Houston County, Polk County, Walker County (18)

Odocoileus virginianus (deer) - Statewide (18)

Dasypus novemcinctus - Widespread, Walker County, Polk County (18)

Pedomys ludovicianus - Almost extinct in Eastern Texas (42)

Mustela frenata - Almost extinct in Eastern Texas (42)

Tadarida mexicana (bat) - East Texas (42)

Reithrodontomys montanus (harvest mouse) - East Texas (42)

An additional listing of vertebrates from the Big Thicket is included in the report of Parks and Cory.

Summary

The Austroriparian province is characterized by the western extent of the southern hardwood forests. In Texas, Tharp (1939) recognized two vegetational regions: the longleaf pine (Pinus palustris) belt in the southeastern part of the province and the pine-oak-hickory forests (loblolly pine, Pinus taeda; yellow pine, Pinus echinata; red oak, Quercus rubra; post oak, Quercus stellata; and blackjack oak, Quercus marilandica) in the remainder of the province. Much of the land has been cut over and is occupied by several communities characterized by different stands of sweetgum (Liquidamber styraciflua), blackjack (Quercus marilandica) and wax myrtle (Myrica cerifera). Where standing water persists, as in the "Big Thicket" region, dense stands of sweetgum, magnolia (Magnolia grandiflora), tupelo (Nyssa sylvatica) and water oak (Quercus nigra) often occur. Two plants which characterize the Austroriparian province are Spanish moss (Tillandsia usneiodes) and palmetto (Sabal glabra). The Big Thicket forest community has recently been described by McLeod (1971).

The vegetation is important in any evaluation of animal fauna. At least 54 species of mammals occur in the province and numerous reptiles and amphibians are known.

According to Blair (1950) five species of mammals (Dasypterus floridanus, Reithrodontomys humilis, Peromyscis gossypinus, Peromyscis nuttalli and Microtus ludovicianus) two snakes (Carphophis amvena and Natrix rigida) eight species of urodeles (Necturus beyeri, Amphiuma means, Ambystoma maculatum, Ambystoma talpoideum, Ambystoma opacum, Desmognathus fuscus, Enrycea longecavda and Manculus quadridigitatus) and four amphibi (Hyla femoralis, Hyla crucifer, Rana palustris and Rana grylio) are limited in Texas to the Austroriparian province.

The region of the Trinity river under consideration that passes through the Austroriparian province provides alluvial soils in the river valleys which support the mesic forests.

The headwaters of the Trinity arise in this province. As described by Tharp (1926) the sandy soils support an oak-hickory forest and the clay soils support a tall grass prairie with such grasses as Agropyron smithii, Andropogon saccharoides, Andropogon scoparius, Stipa leucotricha and Triodia pilosa dominant. There are no endemic species of vertebrates although Blair (3) reported at least 49 species of mammals, 16 species of lizards, 2 turtles, 39 species of snakes and 18 anurans.

The changes that can be expected to result from channelization have been discussed for large game animals and fish. The changes in fauna are associated with loss of suitable breeding sites (differs for many species of minnows and particularly the eight species of darters, family Etheostonidae, recorded from the river). Changes in other fish and fur bearing game animals can be predicted and enhanced by following guidelines purposed by the Texas Game and Fish Commission including zoning of the river for use of pleasure-boaters, water skiers, fishermen and wildlife. The natural populations of species of animals are controlled by a complex equilibrium with the free-living communities of plants and animals. Fishes are usually at the apex of the predator-prey pyramid in freshwaters and are covered by the abundances of other invertebrates on which they rely on for food. This is a normal condition found in any natural environment.

However, if some unusual event occurs in the environment of human or natural origin, the equilibrium between each species in a food web may be disturbed. Regulating mechanisms in the changed environment soon come into play and a new equilibrium will be established. In the intervening period, there may be a serious loss of fishes or other species from the environment.

The complexity of animal life that comprises the food web in that region of the Trinity is not known. As the present survey indicates only a few conspicuous species have been recorded. While several important assemblages of species are known from the headwaters of the Trinity and probably entered to the Reservoir site the exact records of fauna is not available. At present only one reference, Harris and Silvey (64), is available for determining the quality of the environment.

The number of endemic species of animal life present in the site of the reservoir cannot be determined by examining literature records. Endemic species are by definition species occuring in a particular area under consideration and surveys of the Trinity are not available.

Of importance too is the lack of information on ecto- and endoparasites. Ectoparasites such as the had ticks, Dermocenter, Amblyonma, Ixodes and Haemaphysalis occur in riparian to open woodland throughout this area. These ticks are generally considered to be three-host parasites since they have three development stages (instars) which differ in size and infect different sized warm blood hosts at each instar. The common Amblyoma amevianum (Lone star tick) feeds primarily on birds as nymphs and larvae whereas the adult feeds on domesticated and wild animals including dogs and man. Other genera prefer small rodents as hosts for the larvae and larger hosts for the instars. Population peaks generally occur in the spring and summer.

Other than pests which cause minor annoyance during removal, ticks transmit many diseases. Because of their mode of reproduction ticks may retain the disease for as many as five generations. Parasitologically speaking they are biological vectors of Anaplasmosis, Piroplasmosis, Tularemia, Rocky Mountain spotted fever, Colorado tick fever and tick paralysis.

Parasites of fish in impounded reservoirs tends to change extensively and gradually. These changes take place over a period of ten or more years and are due to the following causes:

1) Changes in hydrology resulting from regulation of outflow. Such changes in outflow directly influence parasites with simple developmental cycles Protozoa, the ectoparasitic flatworms (Monogenoidea) and Copepoda. These parasitic fauna, generally, show no qualitative changes. Exceptions are found in those parasites specific to rheophilic fishes which disappear from the reservoirs, and by the addition to the fauna of parasites introduced with acclimatised fishes. Introduced parasites in this latter catagory increase in abundance with time, particularly in the area adjacent to the dam where, the features characteristic of lake environments become established due to

the reduced flow of water (Stolyarou, 1954). Under such conditions the number of parasites reaches levels capable of causing mass mortality of fish. Such epizootics are generally only characteristic of ponds. Several epizootics of this type are well documented for the monogeneaic tremotode Gyrodactylus and parasitic copepods (Smirnova, 1955). The copepods Argulus folioceus caused the mass die off of perch, Lucioperca lucioperca, in reservoirs five years after flooding (Gintout, 1949). Fish measuring 3.5 cm. each harbored 1-2 copepods. One to two copepods per fish was experimentally shown to be sufficient to cause death of fish. Gintout (1949) showed that fish in five years were covered by so many parasites that their scales appeared to be covered by a dirty-green coating.

2) Changes in the invertebrate fauna influencing availability of the intermediate hosts. Internal parasites, such as cestodes, trematode and nematodes, of fishes have life cycles involving intermediate hosts. Population build-ups of these organisms are closely related to that of their intermediate hosts, many of which are invertebrate animals. Extensive changes occur in invertebrate fauna of reservoirs. The formation of a semi-static body of water along the course of a river, resulting in almost complete cessation of current and resultant silting of the bottom destroys the rheophilic benthic biocoenoses. They are replaced by others with characteristics enabling them to exist in water with a drastically lower rate of flow. The zooplankton develops the major features of lakes. In all reservoir situations that have been studied there is a sharp drop in numbers during the first year after filling the reservoir followed by a sharp rise in subsequent years. This fluctuation is concurrent with the changes in the abundance of plankton (Smirnova loc. cit.).

3) Changes in the availability of the final hosts of fish parasites (piscivorous birds, mammals).

The use of reservoir banks by piscivorous birds is of considerable importance to the abundance of larval trematodes particularly those whose advanced larval stages occur in fish causing diseased known as black spot and yellow grub. The adult trematodes are common in herons and shore birds of large bodies of water. These trematodes are reported to cause devastating epizootics under proper conditions for their development (Shigin, 1954). Fish infected with larval stages are unsightly and generally discarded by fishermen.

4) Changes in the fish fauna.

Extinction or suppression of some species and the increase in the abundance of others, as well as the introduction of new fishes changes significantly the relationship of all members of the biocenosie. There is little evidence to support such statements for such changes are only detected years later when mass die offs of normal fishes occur.

The changes that occur in populations of fish and parasites in impoundment of water are important. Discolored fish due to ectoparasites or the presence of large numbers of internal parasites probably does not harm the flesh but most fisherman discard them. When epidemics occur, fishing is greatly reduced.

Recommendations

Due to the extensive changes which are proposed for the Trinity River in the Southwest and in light of the paucity of information concerning this aquatic ecosystem the following recommendations are made.

It is proposed that the first years' study be devoted to organization of the project and a beginning survey of morphometry plankton, fisheries biology, macrophyte productivity and stream biology. During the course of the first year, numerous permanent monitoring and/or collection sites must be established. The selection of these sites will depend upon how rapidly a preliminary survey of sediment types, depth profiles and general river morphology can be completed. Emphasis must be given to localities where the greatest change in river morphology due to dam building is expected to occur. Also the site selection must be closely dependent upon how rapidly individual and group investigative efforts can be correlated with available equipment and technical assistance. Sampling must be adequate to include assemblages of plants and animals important in the ecosystem that are not only numerically dominant but that also may occur seasonally for short periods of time (see Figs. 5, 6, Harris and Silvey, 1940, ref. 64).

It is essential that "baseline" information be gathered and synthesized on the Trinity River before changes in this important river occur due to increased industrialization of the channel. It is proposed that the first year of investigation emphasize the following points.

1. A morphometric survey of the river and its drainage, including drainage area and vegetation, sediment types and distribution, bottom and slope profiles, thermal characteristics degrees of water fluctuation and stream flow.

2. A survey of water quality including pH, oxygen, redox potential, alkalinity, phosphates, specific conductance and perhaps trace micronutrients (Mercury etc.).

3. A initial survey of phytoplankton and zooplankton populations including spatial and temporal distributions, chlorophyll content, oxygen production and C^{14} studies.

4. A preliminary survey of all invertebrate species present, their distribution and productivity, identify endemics.

5. A survey of the fish population in regard to population size, mortality and production rate.

A preliminary plan should be developed to investigate the geology of the Trinity River including core sampling, pollen and diatom stratigraphy, and C^{14} dating procedures. During the subsequent years the emphasis should be three fold:

1. A continued monitoring and additional "baseline" studies on specific taxonomic groups.

2. Experimental studies to produce such data as yield rate coefficients of C^{14} algal photosynthesis,

population dynamics for zooplankton and benthic fauna, effects of increased turbidity of growths of macrophytes.

3. Continual monitoring of ecosystem change during channelization.

It is believed that the responsible acquisition of the information outlined above will be basic to intelligent river management and will provide basis for understanding the role of the Trinity River in Texan economy including consideration of various alternatives involved in water usage in industrial engineering, environmental and recreational programs.

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CHAPTER II

BOTANICAL LITERATURE SURVEY OF THE TRINITY RIVER

by

William F. Mahler
Assistant Professor
Department of Biology

BOTANICAL LITERATURE SURVEY OF THE TRINITY RIVER

Introduction

The principal objective of this report is to assess the botanical research that is pertinent to the Trinity River Basin of Texas. In order to fulfil the stated aim, the literature of several disciplines of the botanical field have been researched. As the information accumulated, it became evident that very little research has actually occurred within the designated study area. Nearly all of the information in this report has been gleaned from individual reports of a much broader and more superficial aspect. Botanists have collected and studied the plants of the eastern and northcentral Texas area for many years and their findings are numerous but scattered throughout the literature (both U.S. and foreign).

A general summary of ecological principles for the interpretation of this report has been included along with a generalized summary of the vegetation zones, an accounting of endemics (both common and rare plus endangered taxa), rare and endangered non-endemics, national and state champion trees, as well as famous trees (historical).

The Bibliography of Agriculture and the Biological Abstracts were searched as well as the SMU Herbarium Reprint Collection. The Gray Herbarium Card Index and Index Kewensis provided the references for the literature on the endemics of the study area while the SMU Herbarium specimens supplemented distributional data recorded in the literature. The basic list of endemics and rare plants was extracted from the Correll-Johnston Manual (1970).

It is unfortunate that this literature survey is not absolute and therefore continued efforts are required in the future for additional references which are certain to be added to the fields of algology, mycology, etc., in addition to those enumerated in this report. I am indebeted to the Librarians of the SMU Science Information Center for their aid and persistence in locating references (both published and unpublished items).

For the purpose of this report, the boundaries of the Trinity River have been established using the counties as outlined in the U.S. Army Corps of Engineers (1962). The following counties are included: Archer, Clay, Montague, Cooke, Grayson, Collin, Denton, Wise, Jack, Young, Parker, Tarrant, Dallas, Rockwall, Kaufman, Van Zandt, Henderson, Ellis, Navarro, Freestone, Anderson, Houston, Leon, Madison, Trinity, Polk, San Jacinto, Walker, Liberty, and Chambers counties.

Ecological Concepts

A brief condensation of the pertinent principles of plant ecology is presented in order that a proper interpretation of the various implications encountered may be achieved. The following concepts generally apply to the temperate zone with each geographic area possessing its own particular group of plant species. In general, most species occur only within a certain vegetation type and on only a part of the continent. The native plant species of the eastern United States do not, for the most part, occur west of the Rocky Mountains and vice versa. Thus, in the United States, there are essentially two large basic floras, the eastern and western. These, in turn, are divided into smaller divisions.

PLANT SUCCESSION

One of the ecological concepts is that of plant succession. A group of different plant species occupies an area until it modifies its immediate environment to the point that they can no longer exist and other invading species gradually take over the habitat to the exclusion of the former occupants. The invading species become the chief occupants of this area until they also modify their own environment to their gradual exclusion only to be replaced by yet another group of invading species. Each group of plants (seral stage) is replaced by another seral stage in a series of successional stages (sere) until a final seral stage is reached which is in accord with that particular climate. This last seral stage (climax) will perpetuate itself indefinitely as long as the climate remains stable.

Two types of succession are recognized, primary and secondary. Primary succession starts from a "bare" substrate such as rock, sand, or water, a slow process, gradually developing soil through the breakdown of rocks, etc., by erosion, and the accumulation of dead plant material. An example of a lithosere (from rock) in a forest region is a sequence as follows: lichens, mosses, ferns, forbs, grasses, shrubs, and trees. A hydrosere (from water) in a forest region would be as follows: floating vegetation, emergent plants, sedges, grasses, shrubs, and trees. The hydrosere is a natural sequence of events following the formation (natural or artificial) of a lake or pond. The gradual accumulation of erosion materials and plant debris fills up the pond passing through the swamp or bog stage and terminates in a dry, upland habitat. If located within a grassland, the former pond will then consist of grasses (climax) or if it occurs within a forest, trees will occupy the pond site (climax). The time element involved will depend upon numerous factors which may increase or decrease the length of time required (see secondary succession).

Secondary succession is the sequence of seral stages from an abandoned field or a blowdown within the forest where a disturbance has changed or eliminated the vegetation but soil still remains. If a plowed field within a forest is left undisturbed, secondary succession will occur and eventually, through the various seral stages, a forest will occupy the area.

A general observation is that the time element necessary for a tropical forest to evolve from an abandoned field is only a year or two and that as one goes north in latitude (or south), the time element increases to hundreds of years (arctic tundra).

Disturbance, either catastrophic or gradual, causes the climax to be replaced by any of the previous seral stages (disclimax). The severity of the disturbance determines which of the lower seral stages will persist. Intensive grazing over a long period of time may result in the forb stage, one of the stage that would occur shortly after abandonment from plowing (grassland). With a constant grazing pressure, any seral stage may be held indefinitely, neither regressing nor advancing to the next seral stage. Range management depends upon this concept for continued maximum forage yields within a seral stage as close to the climax as possible for the climax grassland is the most luxuriant and nutritious in the grasslands.

In the natural course of events, there are naturally disturbed areas which are maintained in various stages of succession over longer periods of time such as creeks and rivers. The young rivers flow straight, fast, and down steeper gradients than the older, slow, meandering rivers with ox-bow lakes and wide floodplain. The vegetation changes slowly and depends on the development of the maturing river. Periodic flooding of rivers is essential to the flushing of accumulations and isolated stagnant pools and for the renewal of nutrients by sediment deposits from the watershed. Plants along the waterway, as well as animals, are physiologically adapted to the periodic stimuli of inundation as are the marine organisms along the coast which are dependent upon the renewal of nutrients by the rivers.

FOOD RELATIONSHIP

Energy flow in a biological system is complex. All living organisms are interacting with one another producing a balanced system. The food chain is one which dissipates the energy bound up in plants with the loss of heat during each conversion from one organism to another. Only the green plants are capable of manufacturing food (carbohydrates, fats, and proteins). All other forms of life, as well as the green plants themselves, are dependent upon this basic process (photosynthesis) and thus, they merely convert what the plants have manufactured into forms which they can utilize through their own metabolism. Plants absorb carbon dioxide and in the presence of light (daytime), chlorophyll (green pigment), and water, photosynthesis occurs in addition to the other processes (respiration and assimilation) common to living organisms. Energy is bound up as food by the plants and the energy is released as the food is utilized by the organisms of the food chain. The energy gradually decreases in amount from one organism to the other because a loss of energy accompanies each transfer in the form of heat. Thus, the organisms involved typically can be grouped in the three following categories: producers (green plants), herbivores, and carnivores.

Upon the death of the plants and animals, the bodies are decomposed by bacterial action and fungi. These forms release carbon dioxide, water, and chemical substances. The chemical compounds released by decomposition are available again for recycling by plants.

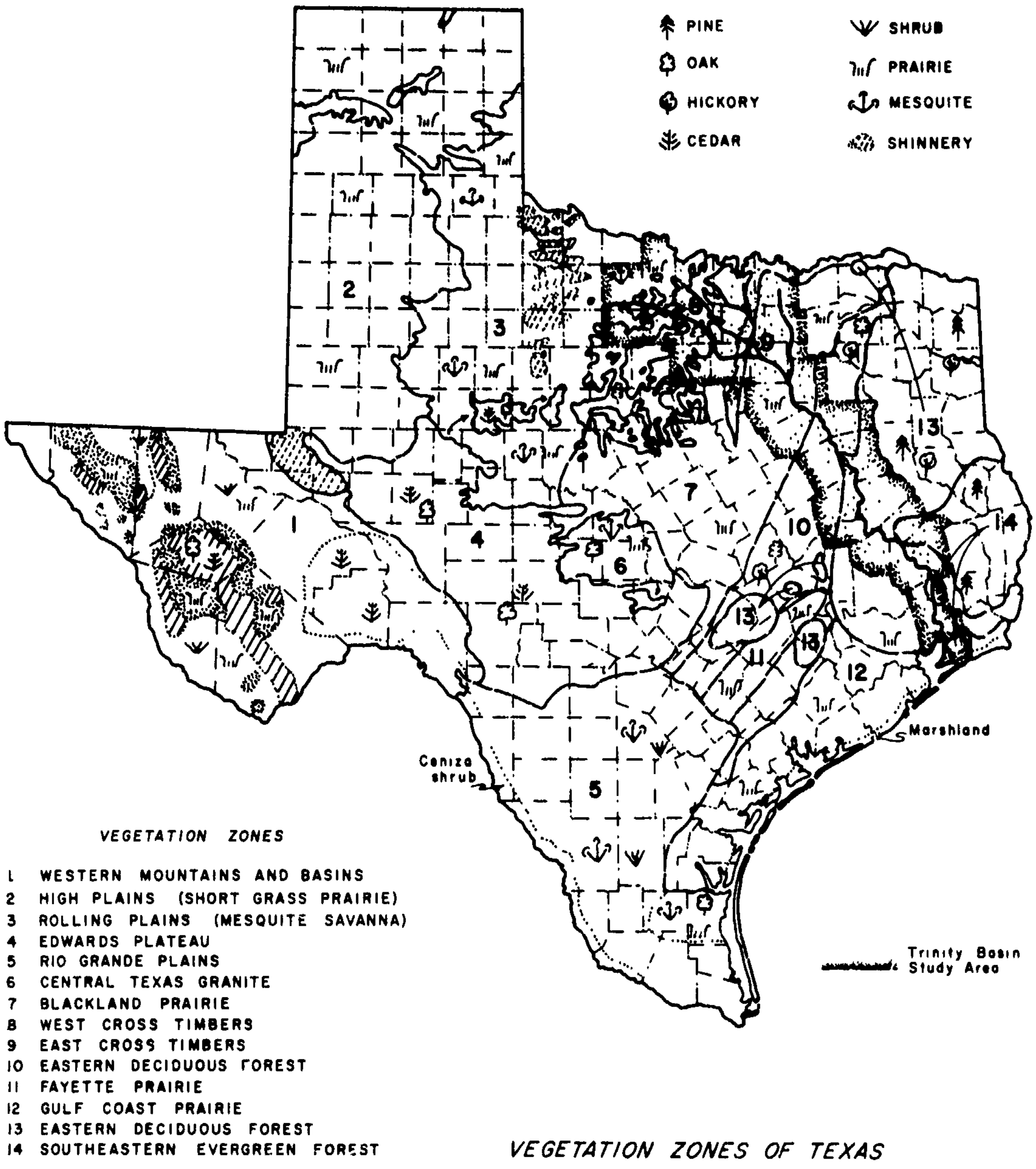

Figure 2. Vegetation zones of Texas.

While living, animals take in oxygen and release carbon dioxide. Green plants absorb carbon dioxide and release oxygen during the day. Photosynthesis occurs at a much higher rate than respiration during the day, while at night, photosynthesis ceases and respiration continues but only to utilize a portion of the excess food manufactured during the day. The phytoplankton of the oceans along with the terrestrial plants (using carbon dioxide) and animals and decomposers (using oxygen) keep the carbon dioxide and oxygen ratio of the atmosphere rather constant.

Plants represent the beginning of the system and the end as well. Without the green plants, life on earth could not exist over a few months; the length of time is proportional to the amount of food stored. Without animals, the carbon dioxide of the atmosphere would eventually become exhausted by being tied up in plant tissues and bring death to the plants.

HABITATS

The habitat is also a living entity but on a smaller scale. Pressures placed upon habitats will have an effect on the vegetation of the earth. The degree of buffering action which the earth's environment can sustain without significant change (detrimental to man; the earth will probably survive regardless) is questionable at this time. Any system, business, or other category is dependent upon all of its parts to make one functional unit. A population of a plant species is a distinct entity. Yet, no single individual will possess all of the characteristics of the population. A single individual cannot possess a mortality rate, natality rate, growth rate, etc. When segments of the population are destroyed, the total population no longer has the same circumscription and the potential for growth, reproduction, etc. will be decreased accordingly.

Vegetation Types

The vegetation types within Texas have been studied by Bray (1906), Tharp (1926, 1939), Allred and Mitchell (1955), and Kuchler (1964). A unification of the above authors is presented on the map (Fig. 2) and a brief discussion of the vegetation types of the study area follows that of Tharp (1926) unless otherwise stated. The vegetation zones occurring within the study area are: 1)Longleaf Pine Forest, 2) Oak-hickory-pine Forest, 3) Oak-hickory Forest, 4) Coastal Prairie, 5) Blackland Prairie, 6) East Cross Timbers (Oak woodland), and 7) West Cross Timbers (Oak woodland).

PINE FOREST (Piney Woods)

This forest is the westernmost part of the Southeastern Evergreen Forest. *Pinus palustris* (longleaf pine) is the dominant plant with other pines occurring in lesser abundance such as *P. taeda* (loblolly pine) and *P. echinata* (shortleaf pine). The forest is usually dense and nearly sterile. Numerous hardwoods occupy the stream bottoms and floodplains. Swamps and low, moist bottomlands are a common feature. The boundary of this vegetation zone is based upon the distribution of *Pinus palustris* (Little, 1971).

Secondary succession. Following local surface fires, which burn slowly, grasses and small shrubs or oaks develop. After an area is cut-over, uncontrollable fires usually occur within a year or so,as a result of the slash, which denudes the area. The first stage of succession consists of *Andropogon tener*, a species of *Aristida*. The second stage of succession consists of small shrubs such as oaks, etc. On cut-over land, the slash (debris, etc.) forms a fire hazard which seldom escapes burning. However, if burning does not occur, longleaf pine seeds and seedlings present on the protected cut-over land will restore the original pine forest (Tharp, 1926).

The concept of longleaf pine constituting the climax vegetation has changed with additional research since that outlined by Tharp (Chapman, 1932; Garren, 1943; Gemmer, *et al*., 1940; Heyward, 1939; Knight, 1965; Wahlenberg, 1935). The current concept recognizes the longleaf pine, in most cases, as a fire disclimax.

Under natural conditions, the climatic climax would be the hardwood trees of the Eastern Deciduous Forest and in succession, the longleaf pine seral stage would immediately precede the climax. The pine seeds and seedlings develop best within sunny, open areas of blowdowns and disturbed areas where hardwood seedlings seldom survive. After the pine trees are established, an environment is created that is favorable to the growth of hardwood seedlings. As the pine trees die, the young hardwood saplings then become dominant. Thus, the pine forest is a temporary forest with a life span of only a few hundred years.

With controlled surface fires, "prescribed burning," the young hardwood seedlings are killed and grass cover reduced without significant damage to the young longleaf pine seedlings. The young seedlings attain a height of 6 to 8 inches and remain dwarfed for several years during which time the root system develops. This is called the "grass stage" because of the numerous fire-resistant needles clustered about the shoot apex. Upon resumed growth, the height of the seedling increases rapidly within a season or two, carrying the terminal bud above the level of the low surface fires. This "sanitation burning" also helps to eradicate the brown spot disease (Hartman, 1949).

A disclimax of longleaf pine is maintained as a result of recurrent disturbance. When fire protection is imposed, the climax of hardwood trees would gradually replace the pines and become established indefinitely. Therefore, controlled burning by man perpetuates the pine disclimax in the southeastern United States.

Hydrosere. The various zones of vegetation or seral stages may be grouped into 3 categories, swamp, bottomland, and upland. Within the swamp, zonal vegetation occurs as 1) submerged aquatics, 2) floating aquatics, 3) rooted aquatics, and 4) erect herbs or trees as a marsh zone. With an accumulation of plant material (leaves, detritis, etc.) the mucky surface becomes drier forming broad floodplains or bottomlands. Three zones were delimited as each one became drier with an increase in elevation. Each successive zone was occupied by more xeric taxa and the bottomlands possessed a rich hardwood growth. On the upland sites, the most xeric, the longleaf pine dominated over the hardwoods (see discussion on Secondary Succession).

BIG THICKET

Parks and Cory (1938) published a "Biological Survey of the East Texas Big Thicket Area" and discussed the history, location, fauna and flora, and included lists of the organisms. Additional studies have added many taxa to the flora in this area since 1938.

The Big Thicket is compared to the history of the Llano Estacado and the Mustang Desert. The latter two have passed from reality to being merely names in history without any definite location today.

The first edition was published in 1936 and proposed that a segment of the Big Thicket be protected from exploitation. After 35 years, no acreage has been set aside in its natural state for future generations. Their map indicates the size of the original Big Thicket; the area is reportedly much smaller today, however the extent or a recent map of the remaining part has not been seen. The original Big Thicket extended into two vegetation zones, the longleaf pine and the oak-hickory-pine forests, several counties of which are included in the study area. The longleaf pine vegetation zone may have coincided with the Big Thicket and may represent the remnants of the former area existing today.

In regard to the plants of the Big Thicket, the slime molds, algae, fungi, lichens, liverworts, and mosses have scarcely been studied. Reference may be found to a few isolated collections but detailed studies are apparently lacking, even after 35 years (see Non-Vascular). The major portion of the work in the Big Thicket was devoted to the vascular plants and the list includes approximately 1500 taxa.

Gow (1905) divided the longleaf pine area into six habitat groups.

OAK-HICKORY-PINE FOREST (Pine-oak)

This forest is an extension of the Eastern Deciduous Forest and is considered as an ecotone by Tharp. The dominants are *Quercus stellata*, *Q. marilandica*, *Q. rubra*, *Carya texana*, *Pinus echinata*. In the northern half of the zone, *Pinus echinata* is the dominant pine while in the southern part, *P. taeda* is dominant. Chambers (1930, 1934) divided this area essentially the same geographically using the economy: northern part - farming, southern part - timber. Pure pine stands tend to have a sterile forest floor while the oak-hickory stands support a dense undergrowth of herbs, shrubs, and small trees. Numerous running springs and streams are a characteristic feature instead of the swamps and broad bottomlands of the pine forest. The western edge of the range of the shortleaf pine (P. echinata) and loblolly pine (P. taeda) is regarded as the western boundary of the oak-hickory-pine forest (Little, 1971).

Secondary succession. According to Tharp, the various stages of succession are dependent upon the prior history of the particular area. The vegetation varies from pure pine stands to mixed to pure hardwood (oak-hickory). The same concept expounded upon in the previous section of secondary succession may be utilized within this vegetation zone.

Fields abandoned from cultivation are often covered with a dense stand of loblolly pine, commonly referred to as "old field pine," in addition to sassafras, persimmon, and Andropogon virginicus.

A study of grazed and ungrazed plots on two forest types within Sam Houston National Forest is summarized (Warner, 1942). An elm-oak bottomland forest study showed that switchcane and Carex provided good late fall and winter grazing when mature. It was protected during the spring and summer for growth and maturation. If not grazed during the fall and winter, a thicket-like understory developed. Seral stages developed in the following sequence: 1) weeds, 2) Carex, 3) switchcane, 4) palmetto, and 5) woody plants. On the pine-oak upland forest sites, the ungrazed plots decreased the carpet grass (which retarded tall grass growth) and tall grasses increased causing a greater fire hazard. In addition, pine reproduction was best under partial shade and a light grass density.

Hydrosere. Swamps are typically absent and Pontederia and Eichhornia decrease and disappear. Different taxa become involved in the formation of the various vegetation zones up to the climax upland forest of oak-hickory.

OAK-HICKORY FOREST

This forest is the westernmost extension of the Eastern Deciduous Forest (provided one continues to follow the zone northward to the Red River and westward to include the East and West Cross Timbers projecting southward). The hickories decrease in number westward until the oaks are the dominant taxa within the East and West Cross Timbers. The dominants are Quercus stellata - post oak, Q. marilandica - blackjack, and Carya texana - black hickory. Rolling sandhills with streams, valleys, and floodplains are characteristic.

Secondary succession. On burned-over land, the dominants possess the ability to resprout and form a dense thicket type of vegetation. On cut-over land, when the sprouts are grazed by livestock, grasses become a dominant seral stage. Old abandoned fields are invaded by forbs (coreopsis - 1 to 2 years), followed by grasses, and then shrubs (sassafras and persimmon), ultimately leading to a climax oak-hickory; however, Bilan and Stransky (1966) recommend the planting of pines within the zone on a field trial basis following their research even though pines are absent in secondary succession within this zone.

Hydrosere. The aquatics and marsh plants are similar to those in the oak-hickory-pine. The floodplain consists of different taxa (willow, cottonwood, elm, ash, pecan, walnut, hackberry) than found in the pine-oak forest. The vegetation of the Carrizo sands was studied by McBryde (1933) and by Kral (1955).

COASTAL PRAIRIE

The low, flat, marshy area of alluvium and sand is considered by Tharp to be a seral stage. The dominant plants are grasses, yet the area is invaded by woody vegetation characteristic of the vegetation types along its borders. Woodland does occur on sandy ridges and along the streams. In Texas, only the Trinity and the San Jacinto rivers flow into the Gulf through wooded bottoms. All of the other Texas streams enter the Gulf by way of marshlands. The invasion by woody taxa is apparently due: 1) to overgrazing, 2) to elimination of prairie fires, and 3) to accelerated seed dispersal of woody taxa.

BLACKLAND PRAIRIE

The Blackland Prairie received its name from the black, clay soils derived from the limestone parent material. The annual precipitation is from about 30 inches in the western part to 40 inches in the easternmost section. Grasses represent the dominant vegetation type even though the grasses may be partially obscured by the spring, summer, and fall annual and perennial forbs in their respective seasonal aspect. The tall grasses, such as bluestems (*Andropogon* spp.), are dominant where protected in the eastern part giving way to shorter grasses westward - buffalo grass (*Buchloe dactyloides*) and gramas (*Bouteloua* spp.). Most of the land is in cultivation with the rough, untillable land usually overgrazed.

The most intensive study of any section of the Blackland Prairie was conducted by Dyksterhuis (1946) on the Fort Worth Prairie. The research covered a 5 year period (1939 - 1944) and included a historical resume, areal description, vegetation, succession, seasonal development and yields of principal grasses. A brief outline on the factors influencing the vegetation of the Fort Worth Prairie (Dyksterhuis, 1946; Winkler, 1915) is presented with the documentation sources included in the bibliography. The chronology of events is as follows:

Pre-Caucasian - Caddoan cultural group; a density of one Indian per 5,000 acres.
1541 - Coronado and 29 horsemen traveled the length of the prairie.
1700 - Strong French and Spanish influence on the Caddoan Indians.
1750 - Wild horses became a factor.
1800 - 1850 - Plains Indians with horses modified pre-Caucasian culture.
1841 - Earliest diary of a traveler (Kendall, 1845).
1850 - 1860 - Settlement by white man.
1850 - Whiting (1850) describes Trinity River, the roads, vegetation, and the area settled by white man.
1852 - Capt. R. B. Marcy's expedition with plant collections from the headwaters of Trinity. Torrey (1853) wrote the report for the botanical part.
1854 - Pope expedition traversed north end of Fort Worth Prairie and did not distinguish between Cross Timbers and Prairie; described vegetation.
1854 - Parker (1856) described months of June and July.
1850 - 1890 - Greer (1935) recalls vegetation encountered as a boy.

1866 - 1885 - Cattle trails, Chisholm and Shawnee, ran the length.
1883 - Barbed wire, drought, and fence-cutting.
1800's - Severe overstocking of ranges, drought, and prairie fires.
1860 - 1930 - 1860: 20 acres per mature cow/yr.
1890: 7 acres per mature cow/yr.
1930: 11 acres per mature cow/yr.

The early reports of expeditions by white man indicated that the vegetation of the prairie was tall and luxurient with grasses and in the spring, wild flowers were bountiful. In the dry, hot summers, the vegetation turned brown and the wild flowers disappeared giving an opposite aspect. The wooded areas were restricted to creeks with game and wildlife abundant.

In the final analysis by Dyksterhuis (1946) following the detailed plot studies, 3 groups were compared: present condition (over the broad area studied), late subsere (7,000 acre ranch carefully managed), and climax (relict climax vegetational areas). The trends in the importance of the principal grass species are presented in charts showing annual grasses and forbs decreasing towards the climax with perennial grasses and forbs increasing. Stipa leucotricha represented the dominant species in the disclimax with Andropogon scoparius as dominant in the climax.

Relations between relief, soils, and vegetation, the seasonal development of vegetation, and monthly yields of principal grasses were also extensively studied and discussed.

Other papers treating the Blackland Prairie are Thomas (1962) and Hill (1901).

WESTERN CROSS TIMBERS

A study similar to that of the Grand Prairie was also conducted by Dyksterhuis (1948) on the vegetation of the Western Cross Timbers. This study is of the same high quality as that of the Grand Prairie and covered 10 years intermittently. A superficial summary is presented.

The Western Cross Timbers is divided into two areas, the Main Belt and the Fringe. The Main Belt is characterized by Red and Yellow Podzolic soils on Cretaceous strata with sandy soils and gentle relief while the Fringe is characterized by immature Reddish Prairie soils on Pennsylvanian strata with gravelly and rocky soils on rugged topography. The understory taxa differ from one belt to the other. The chief characteristic of the Western Cross Timbers vegetatively is the presence of post oak (Quercus stella) and blackjack (Q. marilandica) but the other vegetation varies locally because of the soils and land use.

Climax vegetation. The climax or original vegetation consisted of grasses, the dominants being little bluestem (Andropogon scoparius), Indian grass (Sorghastrum nutans), and big bluestem (Andropogon furcatus). It was concluded that the climax vegetation was grassland and the oaks constituted a postclimax. The savanna was a result of the edaphic factors which prevented the vegetation from being a grassland under that particular climate (climatic climax - monoclimax concept). This area could be considered as an edaphic climax under the polyclimax concept. The vegetation consisted of tall grasses with well-spaced oaks forming a savanna upon settlement by white man.

Floristically, 4 types of vegetation based upon soil types were described: 1) Quercus-Smilax - podzolic soils, 2) Quercus-Prosopis - immature Reddish Prairie soils, 3) Prosopis - mature Reddish Prairie soils, and 4) old field - podzolic soils. The present understory vegetation is a grazing disclimax with oaks having increased to form a woodland or forest.

Secondary succession. Under certain conditions, the succession may reach the climax in 14 years through 4 seral stages: 1) weed stage, 2) annual threeawn stage, 3) splitbeard bluestem stage, and 4) the little bluestem stage. The threeawn stage may persist for years with unrestricted grazing or if seeds of advanced stages are absent.

Grazing coactions, autecological studies of 14 of the most important grasses, 4 typical points in range degeneration, seasonal vegetational data, methods of study, survey of historical literature, soils, geology, and topography were discussed and integrated.

EASTERN CROSS TIMBERS

Studies comparable to those of Dyksterhuis on the West Cross Timbers and the Grand Prairie have not been conducted for the East Cross Timbers or as a matter of fact, anywhere else in Texas.

The early expeditions quite often did not differentiate between the East and West Cross Timbers, particularly if they were north of Red River where the mosaic of prairie and woodland was not as massive in area. The wildlife common and abundant to the whole area (Cross Timbers and Blackland Prairie) included buffalo, bear, deer, antelope, wild boars, partridges, turkeys, as well as Castilian cattle and herds of mustangs. Yet, the ranges evidently were not overgrazed according to the accounts of the vegetation prior to actual settlement by white man.

Endemics

An endemic plant is defined as indigenous or native to the area and not introduced from another geographic area. An endemic 1) is persistent over a small geographic area from a wider distribution in the past, or 2) has evolved in place and is slowly expanding its range. The nature or biology of closely related taxa may indicate the origin or relationship of some endemics upon detailed biosystematic studies. A study of the Californian endemics and their relationships (Stebbins and Major, 1965) illustrate the type of study which should be made in Texas, especially in regard to the study area. The principal problem is that the Texan species have not been studied in the depth that the Californian taxa have been studied. The basic research still needs to be done before that type of study can be meaningful. The approach is different from the one in this report and in future studies, both should be integrated for a better understanding of the role of endemics and their importance to man.

A brief, superficial summary of points that would be pertinent to Texas endemics is presented from the study by Stebbins and Major (1965). The study was an "approach to the problem of determining what floristic and ecological conditions promote 1) the persistence of relict species and 2) the origin of new species. The most satisfactory approach in the long run is to study in detail the ecological relationships, geographic distribution, floristic relationships, and cytogenetics of every endemic species and its nearest relatives."

Endemics may be classified in several ways. There are basically two kinds of endemics: 1) newly evolved taxa (neoendemics) evolving through speciation, and 2) relict taxa (paleoendemics) evolving through the extinction of relatives. Wherry (1944) classified endemics based on behavioral criteria and the narrow environmental tolerances were due either to 1) a depleted genetic constitution or 2) limited habitat factors. Vicarious species represent a special class of endemics and reflect the history and development of a given flora. Stebbins and Major (1965) follow the cytological classification of Favarger and Contandriopoulos (1961) which is elaborated upon as follows:

<u>Paleoendemics</u>. Endemics that are ancient and are becoming extinct (relicts) and includes polyploids with extinct diploid ancestors (paleopolyploids).

<u>Shizoendemics</u>. Endemics evolving by gradual speciation through divergence from parents without any change in chromosome number. The taxa become more distinct with age and further divergence.

<u>Patroendemics</u>. Diploid endemics which have produced widespread polyploids and often have been regarded as infraspecific taxa. Endemics were listed in this category if 1) the group was sampled cytologically and morphologically by a specialist, 2) confined to one or two floristic subdivisions, and 3) tetraploid relatives have wide or wider distribution range than the parents.

<u>Apoendemics</u>. Polyploid endemics which have been produced from more widespread diploid or lower polyploid parents. Vicariant apoendemics are 2 or more polyploid endemics arising from same diploid parents. Endemics were listed in this category if 1) close relatives were diploid or low polyploids and occurred in an adjacent region, and 2) endemic to one or two floristic subdivisions.

Evaluation of Endemics

A coding system has been designed and abbreviations follow after the species name which indicate the occurrence, the successional stage, and the kind of habitat in which it occurs. Each endemic considered to be rare and endangered has an asterisk. The following is a breakdown of the coding system:

Occurrence

I Extremely rare, known only from 1 or 2 localities.
II Rare, but found locally within a 3 or 4 county area.
III Infrequent, wide distribution.
IV Frequent, wide distribution.

Stage of Succession

A. Climax vegetation. This vegetation type will persist until a shift in the climate of that area occurs or is disturbed by some faction which destroys the vegetation type (Forests, grasslands, etc.).

B. Disturbed habitats. These represent seral stages in succession and are temporary. Each seral stage is followed by another seral stage of different taxa (Abandoned fields, most roadsides, etc.).

Habitat

1) Bottomland sites subject to natural flooding.
2) Upland, well-drained sites.
3) Coastal sands.
4) Roadsides subject to extra surface runoff.

DISCUSSION OF CODING SYSTEM

Occurrence. The four (4) categories under this heading are arbitrary and additional study is necessary in order to determine exact status of the individual taxon.

An endemic which plays a role in a particular seral stage of succession would be quite difficult to maintain as a population unless knowledge of the factors preventing the regression or progression to another seral stage is known. A certain amount of knowledge is necessary to cultivate native taxa in gardens and even a greater amount will have to be obtained in order to maintain populations of a particular taxon under natural conditions. An endemic which occurs only within a climax vegetation type is probably already extinct today. Unique habitats still exist but have been subjected to grazing pressures, etc. without adequate buffer zones (such as protection of watershed areas) and therefore do not necessarily represent climax vegetation.

Economically, it is unfeasible to preserve (preservation when the use is not known) all of the type localities from which new species have been collected and described. However, new taxa with restricted ranges or single collections only should be investigated and biosystematic studies, etc. inaugurated preferably on a long term basis. A study of Texan endemics similar to that of Stebbins and Major (1965) would be impossible at this time because of a lack of knowledge of the plants.

Stage of succession. Climax vegetation is rare and only a few areas are known to exist in the study area (Dyksterhuis, 1946, 1948) which have not been disturbed by man. The exact localities were not given and additional information is needed. Thus, man's influence upon this type of vegetation actually negates this part relegating all of this phase to "B. Disturbed Habitats." When "A. Climax Vegetation" is designed for a particular taxon, it is a modification of the concept and merely implies that the plants occur within a shaded forest floor or in an exceptionally good grassland approaching the climax stage. Until adequate studies are made, the selection of one category is based upon indications and this may be false upon closer scrutiny.

Disturbed habitats include any of the seral stages leading to the climax stage. The open areas within a forest, including the edge of the woods qualifies as a disturbed habitat. Man has greatly increased the number and amounts of the category with construction of highways, cities, recreational areas, agricultural practices, etc. With this increase of new habitats for the species prominent in plant succession, there has been an increase in the abundance of species which formerly were restricted to small, local, natural catastrophic areas. Closely related taxa, which are separated by a barrier such as a different soil type, hybridize along the contact areas without the offspring developing into mature plants because of the competition of the other plants, etc. With clays and sands mixed along a roadside, the hybrids are able to persist without the competition (confusing taxonomists who then regard them as varieties) and are potentially new species upon a doubling of the chromosomes (polyploidy). Thus, from this viewpoint, man is speeding up speciation and providing the habitats for the new taxa.

Habitats. With the construction of reservoirs and channels, bottomland habitats become the most vulnerable. The upland sites are typically forested or of native grassland. These sites are subjected to grazing and lumbering and with wise use will not be destroyed. The coastal sands are constantly moving and represent a seral stage usually associated with pioneer communities. Roadsides constitute a disturbed habitat which receives more moisture than adjacent pastures and woodland and is more productive in the amount of vegetation as well as diversity of species.

Vascular Endemics
Within the Trinity River Watershed

The taxa indigenous to Texas enumerated in this study have at least part of their range within the study-area. The distribution maps do not show all of the known localities within a county. Thus, a dot within a county indicates that one or more locations exist. The total range of each taxon is based upon county records reported in the literature and supplemented by plant specimens in the SMU Herbarium. Other herbaria have not been visited and the total range of distribution may be slightly larger in a few instances.

There are 65 Texas endemics that have part or all of their range of distribution within the Trinity River watershed area (Appendix I: III & IV). Of these, 16 taxa are considered rare and endangered according to the coding system (I & II) and are marked with an asterisk and mapped separately immediately following the list. Each kind of plant may be ranked even further in relation to the other fifteen. A major emphasis would be on the bottomland habitats which are subject to channelization and reservoirs.

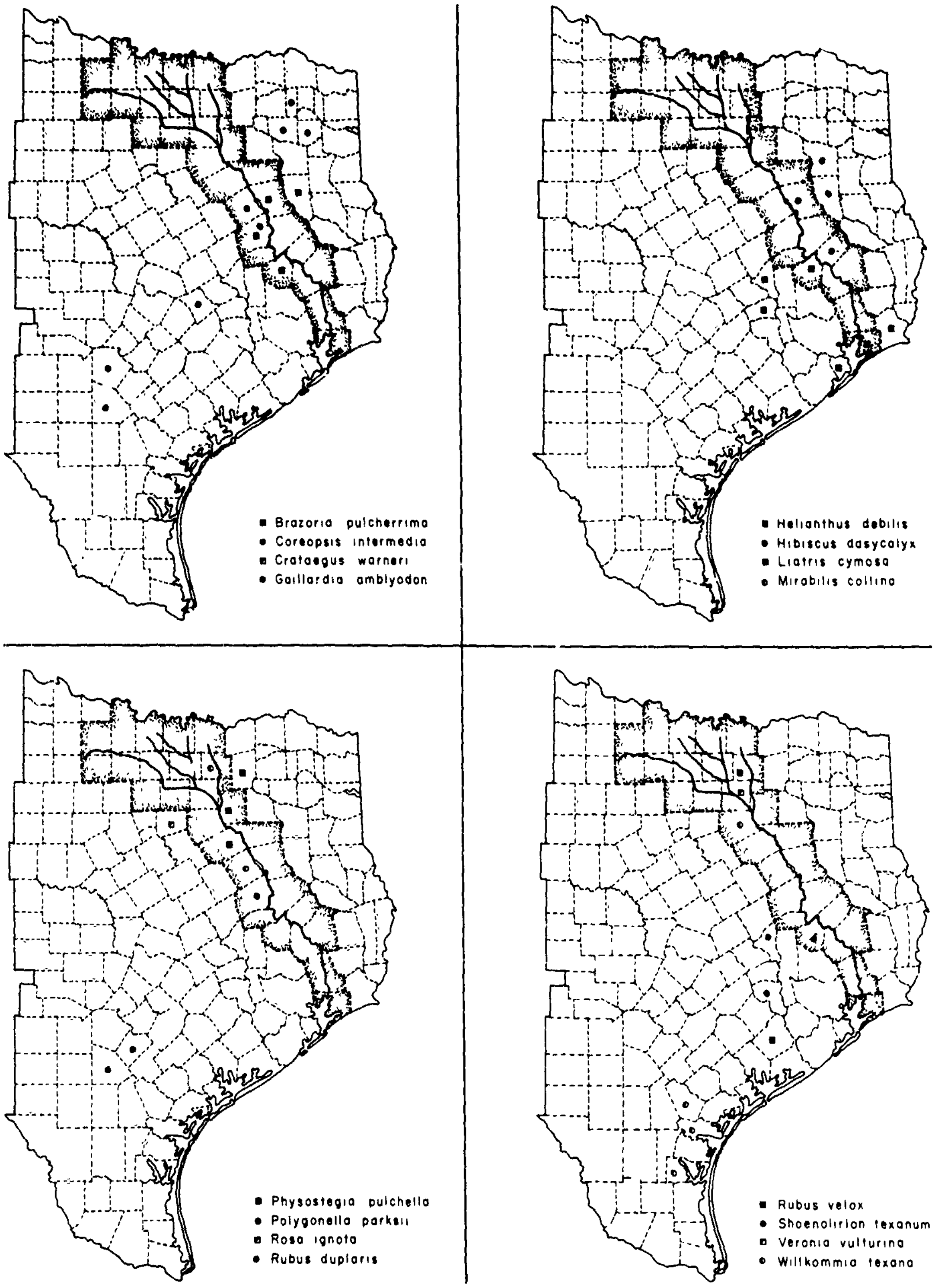

Figure 3. Distribution of vascular endemics within study area.

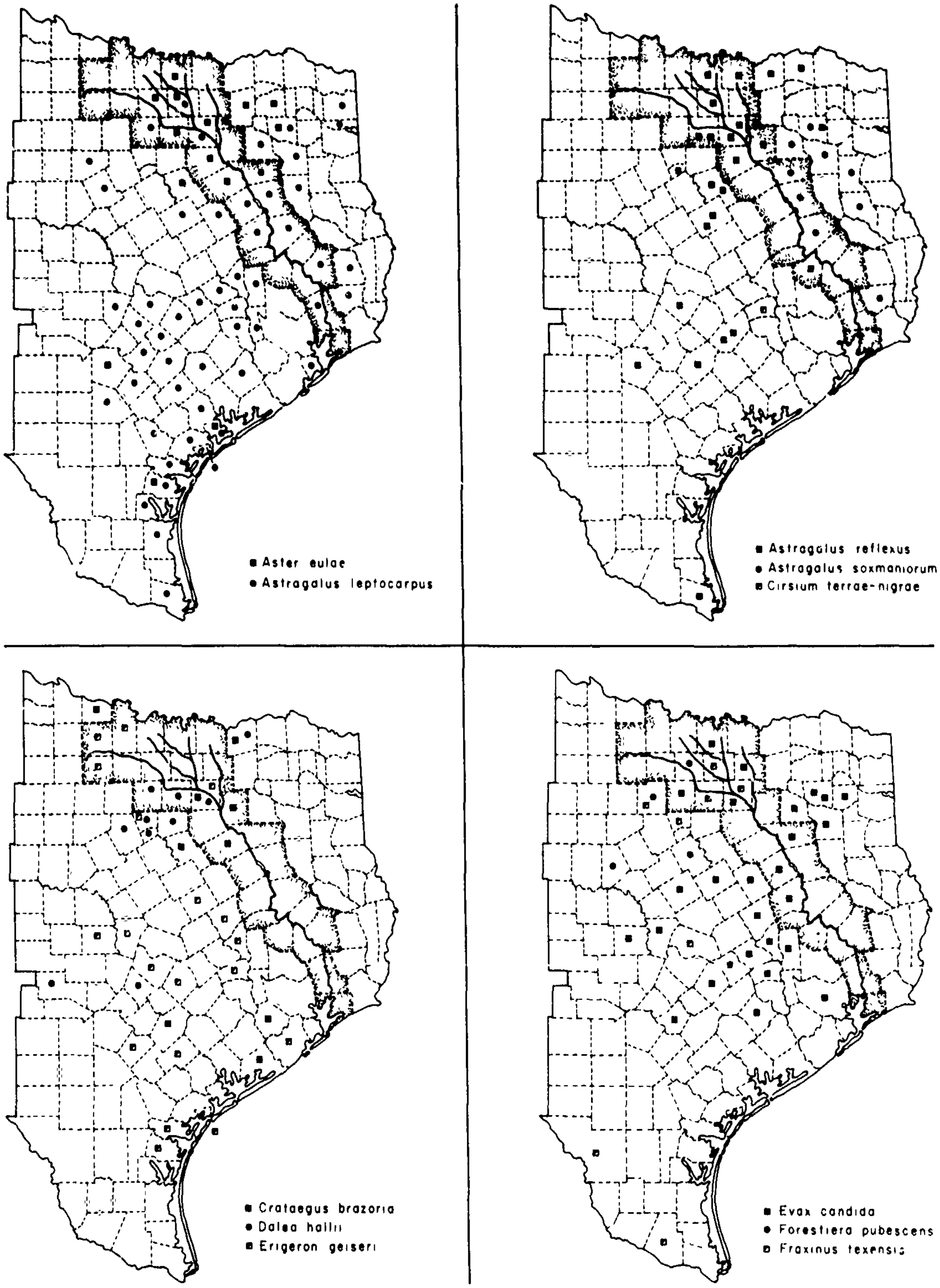

Figure 4. Distribution of vascular endemics within study area.

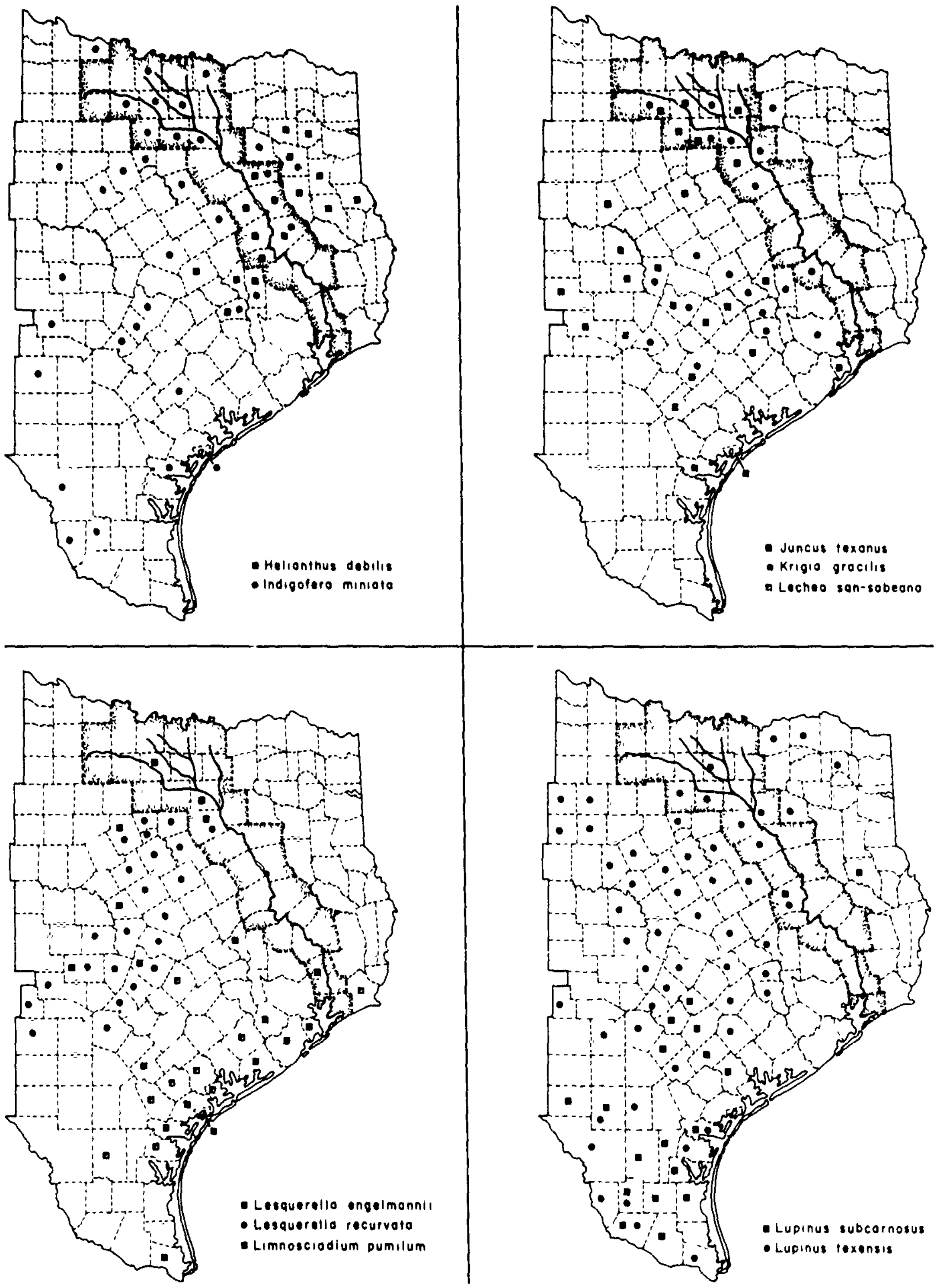

Figure 5. Distribution of vascular endemics within study area.

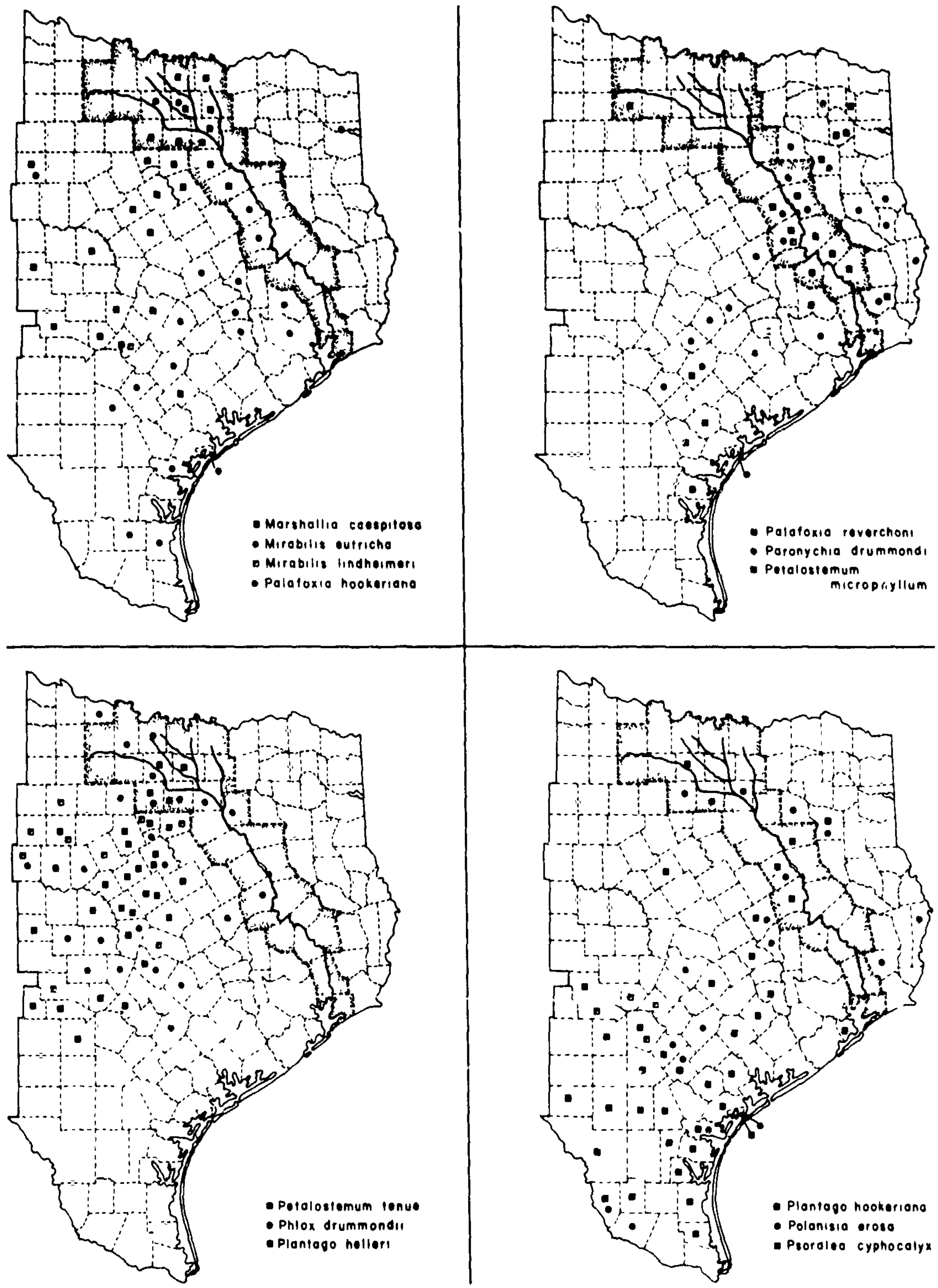

Figure 6. Distribution of vascular endemics within study area.

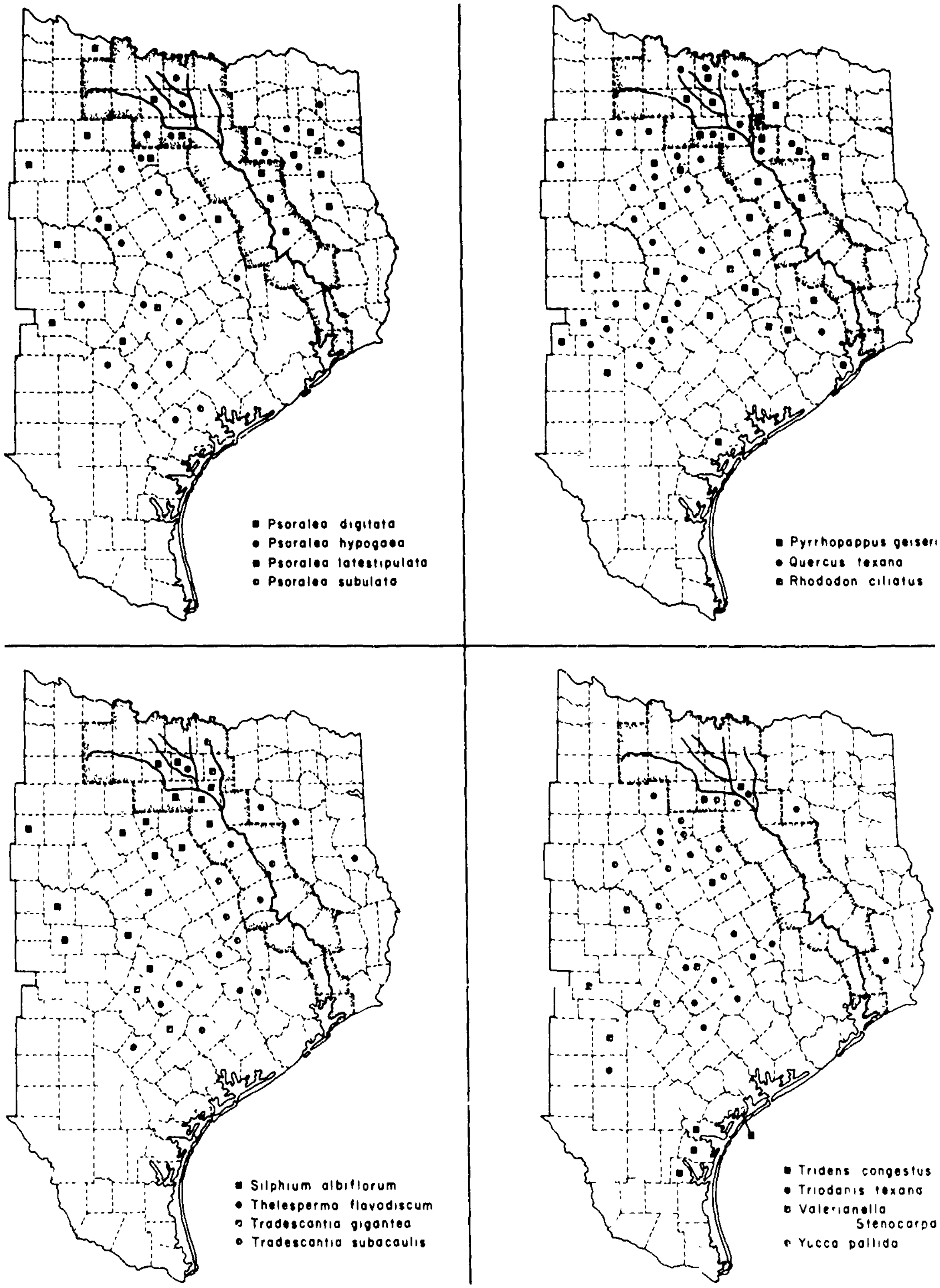

Figure 7. Distribution of vascular endemics within study area.

The extent to which habitats of five of the sixteen bottomland taxa would be destroyed by reservoir flooding and construction is unknown. A question mark indicates that information is not available from the sources examined at this time for that category. Figs. 3 to 7 represent the distribution of the 16 taxa regarded as rare and endangered, coded in the report as I & II.

Aster eulae Shinners, Field & Lab. 18:35. 1950. Heavy clay or clay loam in wooded river bottoms; disjunct populations in south Texas. Type locality: Hill County, 8.6 miles northeast of Hillsboro. IVB1.

Astragalus leptocarpus, Torrey & Gray, Flora of North America. 1:334. 1838. Wide distribution in eastern half of Texas. IVB2.

Astragalus reflexus Torrey & Gray, Flora of North America. 1:334. 1838. Infrequent to rare. IIIB2.

Astragalus soxmaniorum Lundell, Field & Lab. 13:3. 1945. Rare and local. Type locality: Van Zandt County, off Highway 64 near Edom. IIIB2.

*Brazoria pulcherrima Lundell, Wrightia 4: 29. 1968. Type locality and only known location: Leon County, ca. 1 mile south of Centerville of Highway 75. IB4.

Cirsium terrae-nigrae Shinners, Field & Lab. 17:27. 1949. Locally abundant to rare and local. Type locality: Fannin County, 5.5 miles east of Bonham in black clay. IIIB2.

*Coreopsis intermedia Sherff, Botanical Gazette. 88: 299. 1929. Rare. IIA2.

Crataegus brazoria Sargent, Botanical Gazette. 31:233. 1901. Bottomland and wooded hillsides. IIIA1,2.

*Crataegus warneri Sargent, Journal of Arnold Arboretum. 3:184. 1922. Type locality: Anderson County, Palestine. IIA1,2.

Dalea hallii Gray, Proceedings of American Academy. 8(1873):625. Pollen grains differ morphologically from presumed relatives. IVB2,4.

Erigeron geiseri Shinners, Wrightia 1:183. 1947. var. geiseri. Locally abundant. Type locality: Burnet County, IVB2,4.

Evax candida Torrey & Gray, Synoptic Flora of North America. 1(2):230. 1886. Locally abundant. IVB2,4.

Forestiera pubescens Nuttall var. glabrifolia Shinners, Field & Lab. 18:99,100. 1950. Type locality: Bosque County, 12.5 miles north-northeast of Walnut Springs. Taxonomic status uncertain - included under the species by Correll & Johnston (1970). IIIA1.

Fraxinus texensis (Gray) Sargent, Silva of North America. 6:47, pl. 270. 1894. Taxonomic status uncertain; Gray regarded as a variety of F. americana. IVA2.

*Gaillardia amblyodon Gray, Annales des Sciences Naturelles. Series II. 12(1839):62. Sandy prairies. IIB2,4.

Helianthus debilis Nuttall.

*subspecies praecox (Engelmann & Gray) Heiser, Madrono 13:160. 1956. Type locality: Galveston County, Galveston Island. IIB3.

subspecies silvestris Heiser, Madrono 13:160. 1956. locality: Nacogdoches County, 3 miles south of Nacogdoches on Highway 59. IVB2,4.

*Hibiscus dasycalyx Blake & Schiller, Journal of Washington Academy of Science. 48:227. 1958. Rare, only location? Type locality: Trinity County, west of the Neches River ca. 13 miles west of Lufkin (which is in Angelina County). I??

Indigofera miniata Ortega var. leptosepala (Nuttall) B. L. Turner, Field & Lab. 24:104. 1956. IVB2,4.

Juncus texanus (Engelmann) Coville, Small, Flora Southeast United States. 259. 1903. Infrequent aquatic. IIIB1.

Krigia gracilis (de Candolle) Shinners, Wrightia 1:205. 1947. Local and infrequent southward. IIIB1.

Lechea san-sabeana (Buckley) Hodgdon, Rhodora 40:49. 1938. Disturbed habitats. IVB2,4.

Lesquerella engelmannii (Gray) Watson, Proceedings of American Academy. 23:254. 1888. IIIB2,4.

Lesquerella recurvata (Gray) Watson, Proceedings of American Academy. 23:253. 1888. IVB2,4.

*Liatris cymosa (H. Nees) Schumann, Just, Botanische Jahrbucher. 27(1):528. 1901. Infrequent or rare. II?2.

Limnosciadium pumilum (Engelmann & Gray) Mathias & Constance, American Journal of Botany. 28:162. 1941. IV??

Lupinus subcarnosus Hooker, Botanical Magazine table 3467. Mostly in south Texas; state flower. IVB2,4.

Lupinus texensis Hooker, Botanical Magazine table 3492. Wider range than the state flower (L. subcarnosus). IVB2,4.

Marshallia caespitosa de Candolle var. signata Beadle and Boynt, Biltmore Botanical Studies 1:9. pl. 8. 1901. Abundant, IVB1.

*Mirabilis collina Shinners, Field & Lab. 19:176. 1951. Collections few but widespread; needs investigation. Type locality: Wise County, 2.5 miles east of Decatur. IIIB2,4.

Mirabilis lindheimeri (Standley) Shinners, Field & Lab. 19:175. 1951. Possible that future collections and examination of other herbaria will fill in gaps between counties. III??

Palafoxia hookeriana Torrey & Gray, Flora of North America. 2:368. 1842. Frequent in sandy soil. P.h. var. minor Shinners, Field & Lab. 20:98. 1952. Type locality: Harris County, Channelview. The variety is included under the species by Correll & Johnston (1970) and is in need of further study. IIIB2,4.

Palafoxia reverchonii (Bush) Cory, Rhodora 48:86. 1946. Infrequent, sandy wooded areas. IIIA2.

Paronychia drummondii Torrey & Gray, Flora of North America. 1:170. 1838. Has been divided into two subspecies. IVA,B2,3.

Petalostemum microphyllum Torrey & Gray, Heller, Bulletin of the Torrey Botanical Club 26:593. 1899. Filed under Dalea drummondiana Shinners (Southern Methodist University). IVB2.

Petalostemum tenue (Coulter) Heller, Bulletin of the Torrey Botanical Club 26:593. 1899. Rocky limestone. IVB2.

Phlox drummondii Hooker var. mcallisteri (Whitehouse) Shinners, Field & Lab. 19:127. 1951. IV??

*Physostegia pulchella Lundell, Wrightia 2:4. 1959. Bottomlands. Type locality: Kaufman County, north side of Highway 175, ca. 1 mile east of Crandall. IIB1.

Plantago helleri Small, Bulletin of the New York Botanical Garden 1:288. 1899. Correll - Johnston (1970) stated that it probably is in Mexico also. IVB1,2.

Plantago hookeriana Fischer & Meyer, Ind. Sem. Hort. Petrop. 5:39. IVB2,3.

Polanisia erosa (Nuttall) Iltis subspecies erosa, Brittonia 10:56. 1958. Most of the range is within Texas, but it also extends into Oklahoma and Louisiana. IVB2,4.

*Polygonella parksii Cory, Rhodora 39:417. 1937. Deep sands; distribution restricted. II??

Psoralea cyphocalyx Gray, Boston Journal of Natural History. 6:172. 1850. Examination of other herbarium material or future collections may fill in the counties northward. IIIB2.

Psoralea digitata Torrey & Gray var. parvifolia Shinners, Field & Lab. 19:19. 1951. Woodlands. Type locality: Smith County, 1.25 miles northwest of Lindale. IIIA2.

Psoralea hypogaea Torrey & Gray var. scaposa Gray, Boston Journal of Natural History. 6:173. 1850. Includes var. breviscapa Shinners according to Correll & Johnston (1970). IVB2.

Psoralea latestipulata Shinners var. latestipulata, Field & Lab. 19:22. 1951. IVB2.

var. appressa Ockendon, Southwestern Naturalist. 1:81-124. 1965.

Psoralea subulata Bush, Report Missouri Botanical Gardens. 17:120. 1906. Local, sandy soils. IVB2.

Pyrrhopappus geiseri Shinners, Field & Lab. 19:81. 1951. Clay soils. Type locality: Dallas County, Southern Methodist University Campus, University Park. A collection is also known from Pontotoc County, Oklahoma. Correll - Johnston (1970) erroneously considers this taxon as a suite of introgressants between P. multicaulis and P. carolinianus. A recent study (unpublished) considers this taxon to be a variety. IVB2,4.

Quercus texana Buckley, Proceedings of the Academy of Science, Philadelphia. 1860:444. 1861. Rocky, limestone slopes. IVA2.

Rhododon ciliatus (Bentham) Epling, Repertorium Specierum Novarum Regnia Vegetabilis Behefte. Band. 115:14. 1939. Local; Southern Methodist University specimens filed under Hedeoma texanum Cory. III??

*Rosa ignota Shinners, Spring Flora, Dallas - Fort Worth, Texas. 409. 1958. Only known collection. Type locality: Johnson County, Cleburne State Park southwest of Cleburne. IA2.

*Rubus duplaris Shinners, Field & Lab. 22:27. 1954. Type locality and only known location: Freestone County, 13.6 miles south of Fairchild. IB2.

*Rubus velox Bailey, Gentes Herbarum. 5:258. 1943. Type locality: Collin County, near McKinney. Included within R. aboriginum (Correll & Johnston, 1970). I??

*Schoenolirion texanum (Scheele) Gray, American Naturalist. 10:427. 1876. Distribution restricted. IIA,B2.

Silphium albiflorum Gray, Proceedings of American Academy. 19:4. 1883. IVB2.

Thelesperna flavodiscum (Shinners) B. L. Turner, Rhodora 61:245. 1949. Deep sand, oak woods. IIIA2.

Tradescantia gigantea Rose, Contributions United States National Herbarium. 5:205. 1899. Disjunct populations as a result of a lack of collections ? IIIA2.

Tradescantia subacaulis Bush, Transactions Academy of Science, St. Louis 14:185. 1904. Type locality: Navarro County, Dawson. IV??

Tridens congestus (L. H. Dewey) Nash, Small, Flora of the Southeastern United States. 143,1327. 1903. Populations disjunct? IIIA2.

Triodanis texana McVaugh, Wrightia 1:43. 1945. Type locality: Burleson County, Somerville. IVA,B1.

Valerianella stenocarpa (Engelmann) Krok, Konegelige Vetenskaps Academiens Handlingar, Stockholm. 5 n. I. 64. 1864. IIIB1,2.

*Vernonia vulturina Shinners, Field & Lab. 18:25. 1950. Type locality of only known location: Dallas County. Buzzard's Spring, swamp (Exall Park?). I?? Collected ca. 80 years ago.

*Willkommia texana Hitchcock, Botanical Gazette. 35-283. 1903. Type locality: Ellis County, Ennis. II??

Yucca pallida McKelvey, Yuccas Southwestern United States (published by Arnold Arboretum) pt. 2:57. tables 13 and 14. 1947. Blackland prairie. IVB2.

VASCULAR ENDEMICS TO BE EXPECTED WITHIN STUDY AREA

Other endemic taxa which are to be expected within the study area are listed below especially those with localities on each side of the Trinity River and possessing an interrupted distribution pattern. (Fig. 8). With intensive collecting and study, the actual range may be found to be continuous or certain factors may be evident which act as barriers restricting the range to certain localized habitats which are disjunct. Field studies would be required to determine which of the possibilities actually exist. Names have not been included which are now considered as synonyms. Some of the taxa listed are part of a species complex and the nomenclatural status might change upon further biosystematic research (i.e. *Rubus* species). The taxa have not been evaluated as to stage of succession, habitat, or frequency of occurrence.

Amsonia repens Shinners, Field & Lab. 19:126. 1951. Type locality: Wharton County, 2 miles west of Campo.

Aster scabricaulis Shinners, Field & Lab. 21:156. 1953. Type locality: Smith County, 16 miles north west of Tyler.

Bartonia texana Correll, Wrightia 3:191. 1966. Type locality: Tyler County, along Clear Creek, forested hills, 7.5 miles southeast of Colmesneil, Rt. 256.

Bradburia hirtella Torrey & Gray, Flora of North America. 2:250. 1841.

Crataegus cherokeenis Sargent, Journal of Arnold Arboretum. 3:1. 1922. Type locality: Cherokee County, upland thickets near Larissa.

Habranthus texanus (Herbert) Steudel, Nomenclature edition 2. I:717.

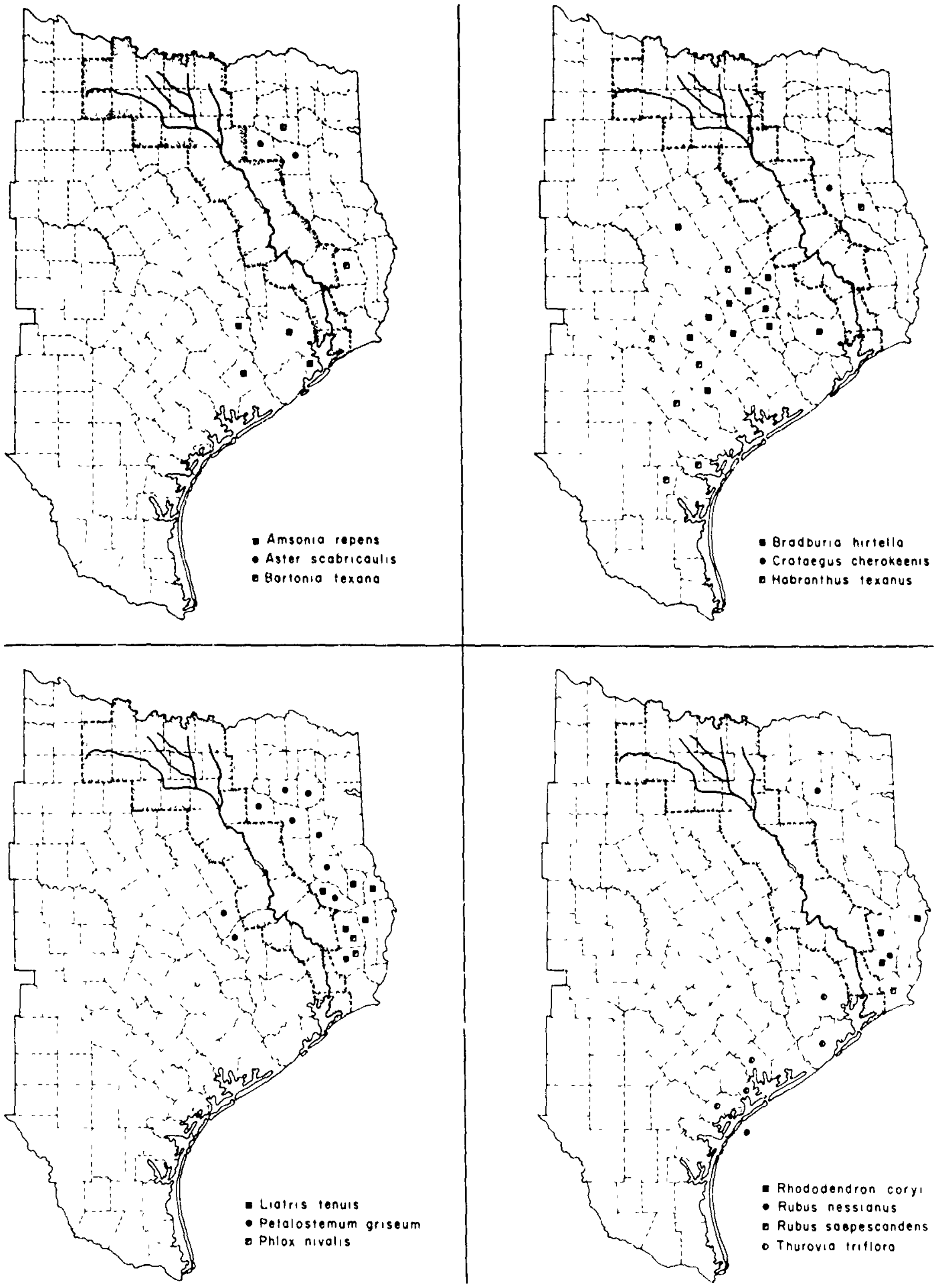

Figure 8. Distribution of vascular endemics to be expected within study area.

Liatris tenuis Shinners, Southwestern Naturalist 4: 208. 1959.

Petalostemum griseum Torrey & Gray, Flora of North America. 1:310. 1838.

Phlox nivalis Loddigs subspecies texensis Lundell, Contributions University of Michigan Herbarium. 8:77. 1942. Type locality: Tyler County, ca. 5 miles north of Warren in pineland.

Rhododendron coryi Shinners, Castanea 26:156. 1961. Type locality: Tyler County, frequent on road right-of-way at pitcher plant bog, Hyatt Bog, 2 miles south of Warren.

Rubus nessianus Bailey, Gentes Herbarum. 5:256. 1943. Type locality: Brazos County, Navasota Bottoms near Bryan.

Rubus saepescandens L. H. Bailey, Gentes Herbarum. 5: 722. 1945. Type locality: Louisiana, Iberia Parish near Gulf, Cypremort Point.

Thurovia triflora Rose, Contributions United States National Herbarium. 3:321. 1895. Type locality: Harris County, prairie northwest of Houston.

Rare Vascular Plants to be Expected Within Study Area

Rare plants are defined for this treatment as those which are relatively scarce and if abundant, restricted to local habitats. In general, the native range of the plants may be primarily in the southeastern United States or in the eastern deciduous forest (eastern half of the United States) and the Texas plants therefore, represent the westernmost edge of the range. For the Great Plains species, the east Texas area would be the southern edge of their range. Some of the plants may be represented on other continents, Europe, Asia, etc., as well as the eastern United States, but are scarce in Texas and represent the extreme limits of their range occurring in certain ecological niches.

Several vegetation regions intersect the study area providing numerous habitats within each region. Within each vegetation region, some habitats may be found which are unique to that particular region but possess characteristics which resemble another vegetation zone. In essence, these unique habitats are "misplaced" and permit plants to survive in spite of the adversity of their general location. The extent to which rare vascular plants occur within the study area is unknown.

Some plants may be rather restricted geographically, occurring in southeastern Oklahoma, Arkansas, Louisiana and Texas, or various combinations thereof. They would not classify as endemics to Texas but are endemics to that geographical circumscription. In this report, this type is included under the category of rare plants when populations are scarce and seldom encountered within the state.

Of the 319 taxa listed as rare, relatively few taxa are introductions, either accidental or intentional. Survival of introductions may depend upon a comparable habitat or the ability to persist in an alien environment. In either case, the plants are potentially capable of (1) becoming a part of the flora in the future or (2) being eliminated.

Common names have been inserted for those having vernacular terms. Many taxa with different scientific names pass unnoticed under one common name. In addition, common names vary from locality to locality. Near the border of Mexico, an English and a Mexican name may be applied to the same plants. There are no international rules governing the application of common names. The more conspicuous the plant and its flowers, the more likely that it will have one or more common names.

Some species have been collected along the borders of adjacent states and there is a good possibility that they will be found within the borders of Texas with additional field work. These taxa are marked with an asterisk (*) and the extent to which they occur in the study area is unknown.

In addition, taxa that are most directly threatened with extinction, as enumerated by the Rare Plant Study Center (University of Texas 1971) are marked with two asterisks (**). The extent to which these 18 occur in the study area is unknown.

FERNS

Lycopodiaceae (Clubmoss Family)

Lycopodium carolinianum L. Slender Clubmoss.

Ophioglossaceae (Adder's-tongue Family)

Ophioglossum crotalophoroides Walt.
** O. nudicaule L.f.
var. tenerum (Prantl) Clausen. Fragile Adder's-tongue.
O. vulgatum L.

Polypodiaceae (True Fern Family)

** Dryopteris cristata (L.) Gray, Crested Shield Fern.

Psilotaceae (Whisk Fern Family)

Psilotum nudum (L) Beauv. Whisk Fern.

Schizaceae (Curly-grass Family)

Lygodium japonicum (Thunb.) Sw.

MONOCOTS

Amaryllidaceae (Amaryllis Family)

Crinum strictum Herb.

Araceae (Arum Family)

*Orontium aquaticum L.

Cyperaceae (Sedge Family)

Bulbostylis ciliatifolia (Ell.) Fern.
Carex alata Torr.
C. comosa Boott.
C. crebriflora Wieg.

C. decomposita Muhl.
C. digitalis Willd.
C. folliculata L.
var. australis Bailey
C. gigantea Rudge
C. gracilescens Steud.
** C. granularis Michx. Meadow Sedge
C. nigromarginata Schwein.
var. floridana (Schwein.) Kukenth.
C. physorhyncha Liebm.
C. stricta Lam.
** C. tenax Chapm. Wire Sedge.
C. tribuloides Wahl.
C. typhina Michx.
C. willdenovii Schkuhr.
Cyperus giganteus Vahl.
C. hermaphroditus (Jacq.) Standl.
C. huarmensis (H.B.K.) M. C. Johnst.
C. reflexus Vahl.
Dichromena latifolia Ell.
Dulichium arundinaceum (L.) Britt. Three-way Sedge.
Eleocharis atropurpurea (Retz.) J. & C. Presl.
E. austrotexana M. C. Johnst.
E. baldwinii (Torr.) Chapm.
E. compressa Sulliv.
E. equistetoides (Ell.) Torr.
E. fallax Weath.
E. flavescens (Poir.) Urban
E. lanceolata Fern.
E. melanocarpa Torr.
E. minima Kunth.
E. radicans (A. Dietr.) Kunth.
E. wolfii (Gray) Patt.
Fuirena scirpoidea Michx.
Psilocarya nitens (Vahl) Wood.
Rhynchospora capitellata (Michx.) Vahl.
R. divergens M. A. Curtis
R. fascicularis (Michx.) Vahl.
R. filifolia Gray
R. grayi Kunth
R. macra (Clarke) Small.
R. microcarpa Gray
R. mixta Small
R. oligantha Gray

R. perplexa Small
R. plumosa Ell.
R. pusilla M. A. Curtis
R. rariflora (Michx.) Ell.
Scirpus cubensis Poepp. & Kunth.
Scleria nutans Kunth
S. baldwinii (Torr.) Steud.
S. minor (Britt.) Stone
S. brittonii Core

Eriocaulaceae (Pipewort Family)

Eriocaulon kornickianum Van Heurck & Muell. Arg.
E. septangulare With.

Gramineae (Grass Family)

Agrostis palustris Huds.
Andropogon elliottii Chapm.
Anthaenantia villosa (Michx.) Beauv.
Aristida basiramea Vasey
A. dichotoma Michx.
A. ramosissima Gray.
Axonopus compressus (Sw.) Beauv.
Bothriochloa exaristata (Nash) Henr.
Bromus molliformis Lloyd.
B. rigidus Roth. Ripgut.
Chloris distichophylla Lag.
** Danthonia sericea Nutt. Downy Danthonia.
D. spicata (L.) Beauv.
** Diarrhena americana Beauv. American Beakgrain.
Digitaria serotina (Walt.) Michx. Dwarf Crabgrass.
Eragrostis amabilis (L.) Nees.
E. capillaris (L.) Nees. Lacegrass.
E. ciliaris (L.) R. Br.
E. elliottii Wats.
E. glomerata (Walt.) L. H. Dewey
E. pilosa (L.) Beauv. India Lovegrass.
E. poaeoides Beauv.
Erianthus contortus Baldw. Bent-awn Plumegrass.
E. strictus Baldw. Narrow Plumegrass.
Festuca obtusa Biehler. Nodding Fescue.
F. paradoxa Desv.
Glyceria arkansana Fern.
G. septentrionalis Hitchc.

Gymnopogon brevifolius Trin.
Heteropogon melanocarpus (Ell.) Benth. Sweet Tangle-head.
Hydrochloa caroliniensis Beauv.
Leptochloa panicoides (Presl) Hitchc.
Lolium temulentum L. Darnel.
Manisuris altissima (Poir.) Hitchc.
Muhlenbergia frondosa (Poir.) Fern Wirestem Muhly.
M. glabriflora Scribn.
M. sobolifera (Muhl.) Trin.
M. sylvatica (Torr.) Torr.
Paspalum almum Chase. Comb's Paspalum.
P. amarum Ell.
P. boscianum Flugge. Bull Paspalum.
P. clandestinum L.
P. convexum H. & B.
P. depauperatum Muhl.
P. ensifolium Ell.
P. flexile (Gatt.) Scribn.
P. longifolium Torr.
P. minus Fourn.
P. ovale Ell.
P. philadelphicum Trin.
P. portoricense Hamilt.
P. repens L.
P. tenerum Beyr.
Poa chapmaniana Scribn.
P. sylvestris Gray
Schizachyrium tenerum Nees.
Setaria corrugata (Ell.) Schult.
Sphenopholis intermedia (Rydb.) Rydb.
Sporobolus heterolepis (Gray) Gray. Prairie Dropseed.
S. silveanus Swall.
Vulpia dertonensis (All.) Volk.
V. megalura (Nutt.) Rydb. Foxtail Fescue.
V. myuros (L.) C. C. Gmel.

Iridaceae (Iris Family)

Iris fulva Ker. Red-flag.
I. pseudacorus L. Yello-flag.
Nemastylis nuttallii Pick.

Juncaceae (Rush Family)

Juncus capitatus Weigel.
J. debilis Gray.
J. megacephalus M. A. Curtis
J. polycephalus Michx.
J. trigonocarpus Steud.
Luzula echinata (Small) Herm.
var. mesochorea Herm.

Lemnaceae (Duckweed Family)

Lemna trisulca L. Ivy Duckweed.
Spirodela oligorhiza (Kurtz) Hegelm.
Wolffia punctata Griseb.
W. gladiata (Hegelm.) Hegelm.
Wolffiella lingulata (Hegelm.) Hegelm.

Liliaceae (Lily Family)

Smilax herbacea L. Carrion-flower.
S. walteri Pursh.
Trillium recurvatum Beck.
T. texanum Buckl.
Zigadenus leimanthoides Gray.

Orchidaceae (Orchid Family)

** Calopogon barbatus (Walt.) Ames. Bearded Grass-pink.
Cleistes divaricata (L.) Ames. Spreading Pogonia.
Erythrodes querceticola (Lindl.) Ames.
Habenaria integra (Nutt.) Spreng. Yellow Fringeless Orchid.
H. lacera (Michx.) Lodd. Ragged Fringed Orchid.
Spiranthes gracilis (Bigel.) Beck.
var. brevilabris (Lindl.) Correll. Texas Ladies' Tresses.
S. parksii Correll

Palmae (Palm Family)

** Sabal louisiana (Darby) Bonhard. Louisiana Palm.

DICOTS

Amaranthaceae (Amaranth Family)

Alternanthera pungens H.B.K.
Amaranthus albus L.

Apocynaceae (Dogbane Family

Amsonia glaberrima Woods

Aquifoliaceae (Holly Family)

** Ilex ambigua (Michx.) Torr. Carolina Holly, Sand Holly.
I. myrtifolia Walt.

Berberidaceae (Barberry Family)

Podophyllum peltatum L.
f. deamii Raymond. Purplish May-apple.

Boraginaceae (Borage Family)

Lappula echinata Gilib.

Caprifoliaceae (Honeysuckle Family)

Triosteum angustifolium L.

Compositae (Sunflower Family)

Acanthospermum australe (Loefl.) O. Ktze. Paraguay Green-stripe.
Ambrosia bidentata Michx. Southern Ragweed.
Aster azureus Lindl.
A. scabricaulis Shinners.
Bidens mitis (Michx.) Sherff.
Centaurea solstitialis L. Barneby star-thistle.
Cirsium muticum Michx. Swamp-thistle.
Conyza bonariensis (L.) Crong.
Coreopsis linifolia Nutt.
C. tripteris L.
Crepis pulchra L.
Doellingeria umbellata (Mill.) Nees.
var. latifolia (Gray) House.

Erigeron annuus (L.) Pers. Daisy-fleabane.
E. pulchellus Michx. Robin's-plantain.
Eupatorium capillifolium (Lam.) Small. Dog-fennel.
E. fistulosum Barr. Joe-pye-weed, Trumpet-weed.
E. hyssopifolium L.
E. ivaefolium L.
E. leucolepis (DC.) T. & G. Justice-weed.
E. linearifolium Walt.
Hedypnois cretica (L.) Willd.
Helenium drummondii Rock.
Helianthus annuus L.
subsp. *annuus*. Mirasol, Common Sunflower.
H. grosse-serratus Martens.
H. salicifolius Otto & Dietr.
H. tuberosus L. Jerusalem Artichoke.
**Heterotheca oligantha* (Chapm.) Harms.
Hymenoxys texana (Coult. & Rose) Cockll.
Hypochoeris microcephala (Sch. Bip.) Cabrera
var. *albiflora* (O. Ktze.) Cabrera.
Ionactis linariifolia (L.) Greene.
Iva imbricata Walt.
Liatris squarrulosa Michx.
L. tenuis Shinners.
Machaeranthera aurea (Gray) Shinners.
Parthenium hispidum Raf. Feverfew.
Pluchea rosea Godfrey.
Prenanthes altissima L.
P. barbata (T. & G.) Milstead.
Rudbeckia missouriensis Boynt. & Beadle.
R. nitida Nutt.
var. *texana* Perdue.
Senecio glabellus Poir. Butterweed.
S. tomentosus Michx.
Silphium laciniatum L. Compass-plant.
** *Solidago auriculata* Shuttlew. Earleaf Goldenrod.
S. caesia L. Blue-stem Goldenrod.
S. missouriensis Nutt.
var. *fasciculata* Holz.
S. salicina Ell.
S. tortifolia Ell.
Solvia stolonifera (Brot.) Loud.
Verbesina alternifolia (L.) Britt. Wingstem.
Vernonia altissima Nutt.

Convolvulaceae (Morning Glory Family)

Calystegia sepium (L.) R. Br.
var. repens (L.) Gray. Hedge-bindweed.
Ipomoea corymbosa (L.) Roth. Christmas Vine.
I. shumardiana (Torr.) Shinners.
I. tuba (Schlecht.) G. Don. Railroad Vine.

Cruciferae (Mustard Family)

Leavenworthia aurea Torr.
Lesquerella angustifolia (T. & G.) Wats.
L. pallida (T. & G.) Wats.
Selenia aurea Nutt.

Cucurbitaceae (Gourd Family)

Cucumis anguria L. Bur Gherkin

Cyrillaceae (Cyrilla Family)

*Cliftonia monophylla (Lam.) Sarg. Buckwheat-tree.

Ericaceae (Heath Family)

Vaccinium caesium Greene.

Euphorbiaceae (Spurge Family)

Acalypha rhomboidea Raf.
Phyllanthus urinaria L.
Tragia smallii Shinners.
T. urens L.

Gentianaceae (Gentian Family)

Bartonia verna (Michx.) Muhl.

Geraniaceae (Geranium Family)

Geranium dissectum L.

Haloragaceae (Water-milfoil Family)

Proserpinaca pectinata Lam.

Hypericaceae (St. John's-wort Family)

Hypericum cistifolium Lam.
H. tubulosum Walt.

Juglandaceae (Walnut Family)

** Carya myristicaeformis (Michx. f.) Nutt. Nutmeg Hickory, Nogal.

Labiatae (Mint Family)

Blephilia ciliata (L.) Benth.
B. hirsuta (Pursh) Benth. Wood Mint.
Lycopus virginicus L. Virginia Bugle-weed.
Pycnanthemum clinopodioides T. & G.
P. muticum Pers.

Lauraceae (Laurel Family)

Cassytha filiformis L. Woe-vine, Love-vine.
** Lindera benzoin (L.) Bl. Spice bush, Benjamin Bush.

Leguminosae (Bean Family)

Amorpha fruticosa L.
var. crocreolanata (P. W. Wats.) Mouillef. Bastard Indigo.
A. laevigata T. & G.
Baptisia leucantha T. & G. Wild Indigo.
Crotalaria purshii DC. Rattlepod.
Desmanthus brevipes B. L. Turner
Desmodium cuspidatum (Willd.) Loud.
D. fernaldii Schub.
D. lineatum DC.
D. nudiflorum (L.) DC.
D. nuttallii (Schindl.) Schub.
D. obtusum (Willd.) DC.
D. pauciflorum (Nutt.) DC.
D. strictum (Pursh) DC.
D. tortuosum (Sw.) DC.
** Dioclea multiflora (T. & G.) Mohr. Boykin Clusterpea.
Galactia erecta (Walt.) Vail
G. macreei M. A. Curtis

Lespedeza capitata Michx. Roundhead Bush-clover.
L. violacea (L.) Pers. Prairie Clover
Petalostemum decumbens Nutt.
P. phleoides T. & G.
P. purpureum (Vent.) Rydb.
Phaseolus polystachios (L.) B.S.P.
Rhynchosia difformis (Ell.) DC.
R. tomentosa (L.) H. & A.
Robinia hispida L. Bristly Locust.
Sesbania punicea (Cav.) Benth.
Trifolium resupinatum L. Persian Clover.
Vicia caroliniana Walt. Pale Vetch, Wood Vetch.
V. reverchonii Wats. Hairy-pod Vetch.
Zornia gemella (Willd.) Vog.

Lentibulariaceae (Bladderwort Family)

Ultricularia purpurea Walt. Purple bladderwort.
U. vulgaris L. Common bladderwort.

Lythraceae (Loosestrife Family)

Cuphea carthagensis (Jacq.) Macbr.
C. glutinosa Cham. & Schlecht.
C. viscosissima Jacq. Blue Waxweed.

Magnoliaceae (Magnolia Family)

Schisandra coccinea Michx. Wild Sarsaparilla, Bay Star-vine.
** Magnolia ashei Weath.
M. fraseri Walt. Mountain Magnolia, Ear-leaved Umbrella-tree.
** M. pyramidata Pursh. Pyramid Magnolia.

Malvaceae (Mallow Family)

Anoda pygmaea Correll.

Melastomataceae (Melastoma Family)

Rhexia alifanus Walt.

Onagraceae (Evening Primrose Family)

Ludwigia hirtella Raf. Spindle-root
Oenothera sessile (Penn.) Munz.

Orobanchaceae (Broomrape Family)

Orobanche fasciculata Nutt.
var. subulata Goodman

Plantaginaceae (Plantain Family)

Plantago elongata Pursh.

Podostemaceae (River-weed Family)

*Podostemon ceratophyllum Michx. Thread-foot.

Polemoniaceae (Phlox Family)

Phlox carolina L. subsp. angusta Wherry.

Polygonaceae (Knotweed Family)

Persicaria hydropiper (L.) Opiz. Water Smartweed.
Polygonum tenue Michx.
Rumex acetosella L. Sheep sorrel.

Ranunculaceae (Crowfoot Family)

Clematis beadlei (Small) Erickson.
C. dioscoreifolia Levl. & Van.
C. viorna L. Leather-flower, Vase-vine.
Isopyrum biternatum (Raf.) T. & G. False Rue-anemone.
Thalictrum arkansanum Boivin
Xanthorhiza simplicissina Marsh. Yellowroot, Brook-feather.

Rosaceae (Rose Family)

** Amelanchier arborea (Michx. f.) Fern. Shadblow, Serviceberry.

Rubiaceae (Madder Family)

Hedyotis purpurea (L.) T. & G.
Mitracarpum hirtum (L.) DC.

Sapotaceae (Sapodilla Family)

Bumelia lycioides (L.) Pers.

Saxifragaceae (Saxifrage Family)

Decumaria barbara L. Wood-vamp.
** _Parnassia asarifolia_ Vent. Grass-of-parnassus.
P. grandifolia DC.
Philadelphus pubescens Lois.

Scrophulariaceae (Figwort Family)

Agalinis caddoensis Penn.
Linaria vulgaris Mill.
Mimulus ringens L.

Theaceae (Camellia Family)

** _Stewartia malacodendron_ L. Silky Cammellia.

Umbelliferae (Parsley Family)

Osmorhiza longistylis (Torr.) DC. Anise-root.

Violaceae (Violet Family)

Viola esculenta Ell.
V. lanceolata L. Lance-leaved violet.
V. nephrophylla Greene.
V. stenoloba LeConte.
V. triloba Schwein.

Zygophyllaceae (Caltrop Family)

*_Tribulus cistoides_ L. Burr Nut.

Non-vascular Literature

The cryptogamic literature (non-vascular plants) has been segregated and is under its own caption within the bibliography.

BRYOPHYTES (Mosses and Liverworts).

Within the designated counties of the study area, only 3 liverworts and 136 mosses are recorded. In 1955, Whitehouse reported a total of 84 species of liverworts for the state and in 1954 (Whitehouse and McAllister) reported 289 species and 33 varieties of mosses for Texas. These results show that very little research has been conducted within the study area for this group.

LICHENS

Whitehouse (1934) listed 56 species of lichens and only 1 was from the study area. Sixteen new taxa were reported for the state of which one was from Houston County (Reese and Tucker, 1970). Very little collecting has been done within the study area. A Dallas County (Davis, 1938) study has apparently not been published.

ALGAE, FUNGI

No citations were encountered regarding Texan taxa of algae within or near the study area other than the study of Murphy (1963). Only a few citations were found regarding the fungi. Research within this field has not been concerned with the study area and only a few taxa have been reported and thus ratings of occurrence (common, rare, etc.) cannot be evaluated.

Transplanting and Relocation of Rare and Endemic Plants

TERRESTRIAL PLANTS (vascular).

Some of the vascular plants may be successfully grown as ornamentals if flowers and vegetative characteristics are conspicuous and possess an esthetic appeal. However, many of the plants are small, inconspicuous, and pass unnoticed in their natural habitats, thus not qualifying for use as an ornamental. Regardless of their potential value as cultivated plants, perpetuation of the taxa could be maintained upon adequate studies involving soil, moisture, fertilizer, and other requirements. Exceptions are certain orchids which nearly always die upon transplanting into gardens but can be maintained in greenhouses.

AQUATIC PLANTS.

Vascular. Many factors are involved in the growing of aquatic plants within aquaria or small ponds. Certain taxa will reproduce and increase favorably under a controlled aquatic environment. Other plants, however, die quickly. Investigations regarding the individual requirements would be necessary in order that different plants with the same habitat requirements could be grown together.

Semi-aquatic vegetation is subjected to periodic inundation and studies would have to be initiated regarding the tolerance of these taxa to either the terrestrial or aquatic garden type environment.

Non-vascular. Algae, fungi, and bryophytes are seldom grown as ornamentals within a garden environment in this country. Unless aquatic algae and fungi are grown in a controlled pure culture, the various populations will vary to the exclusion of certain taxa under particular physical characteristics of the aquatic medium. Many of the mosses and liverworts would also fall into this category. Therefore, the transplanting of cryptogams for perpetuation of individual taxa in a garden type environment would be financially unfeasible.

The cheapest method, either now or in the future, for the perpetuation of cryptogamic plants is to preserve the habitat in which they grow. The various habitats of the different vegetation zones within the state of Texas cannot be duplicated or reconstructed by man with his limited knowledge of the factors involved.

SUMMARY

Summarizing, it is not economically feasible to transplant cryptogams into a garden type environment. The preservation of the individual, local habitats is the most economical method for the perpetuation of cryptogams and their associates.

Paleobotanical Studies

Plant fossils have been named and described from two (2) counties, Freestone and Trinity. In addition, the flora of the Wilcox group in Anderson County consisted of 3 taxa while in Freestone County the same group contained 8 taxa as well as Beyer's report (1961).

NEW TAXA

Freestone County (Berry, 1922a) - *Calatoloides eocenicum* Berry: Sandstone (casts) in Wilcox Eocene exposed at the Butler Salt dome.

Trinity County (Berry, 1914) - *Phoenicites occidentalis* Berry: Outcrop, Catahoula formation; cut on the International and Great Northern Railroad in southern Trinity County at spur to the Government Lock and main line.

FLORAS (Wilcox group; Berry, 1922b)

Anderson County - 10 miles south-southwest of Palestine in post-oak prairie, 2 miles south of Needmore.

Canavalia eocenica Berry ?
Lygodium binervatum (Lx) Berry
Nectandra pseudocoriaca Berry ?

Freestone County - 6 miles northeast of Oakville, Butler (or West Point) salt dome near Trinity River.

Canavalia eocenica Berry ?
Lygodium binervatum (Lx) Berry
Nectandra pseudocoriacea Berry ?
Mespilodaphne coushatta Berry ?
Palmocarpor butlerensis Berry
Proteoides wilcoxensis Berry
Sophora repandifolia Berry
Calatoloides eocenicum Berry

PETRIFIED WOOD

Freestone County - petrified sequoian wood; Claiborne group (Beyer, 1961).

Palynological Studies

Studies of bog pollen have been conducted in nearby counties but no studies within the area designated. It is appropiate to mention these studies as the Carrizo sands cross the study area in a northeast direction and one of the studies was conducted in Lee County (Potzger and Tharp, 1947) in a bog located in the Carrizo sands. Other studies were conducted in Lee County (Potzger and Tharp, 1943) and in Milam and Robertson Counties (Potzger and Tharp, 1954). These areas are in the post-oak vegetation zone which occurs within the study area.

Trees of Importance

Two publications regarding the marking, preserving, and publishing of information on famous, important trees of Texas are from the Texas Forest Service (1970; 1971).

FAMOUS TREES

There are ten (10) trees of historical importance listed and described from the watershed of the Trinity River (Famous Trees of Texas, 1970). Of the ten, four (81, 61, 111 and 43) are located within the city limits with adequate

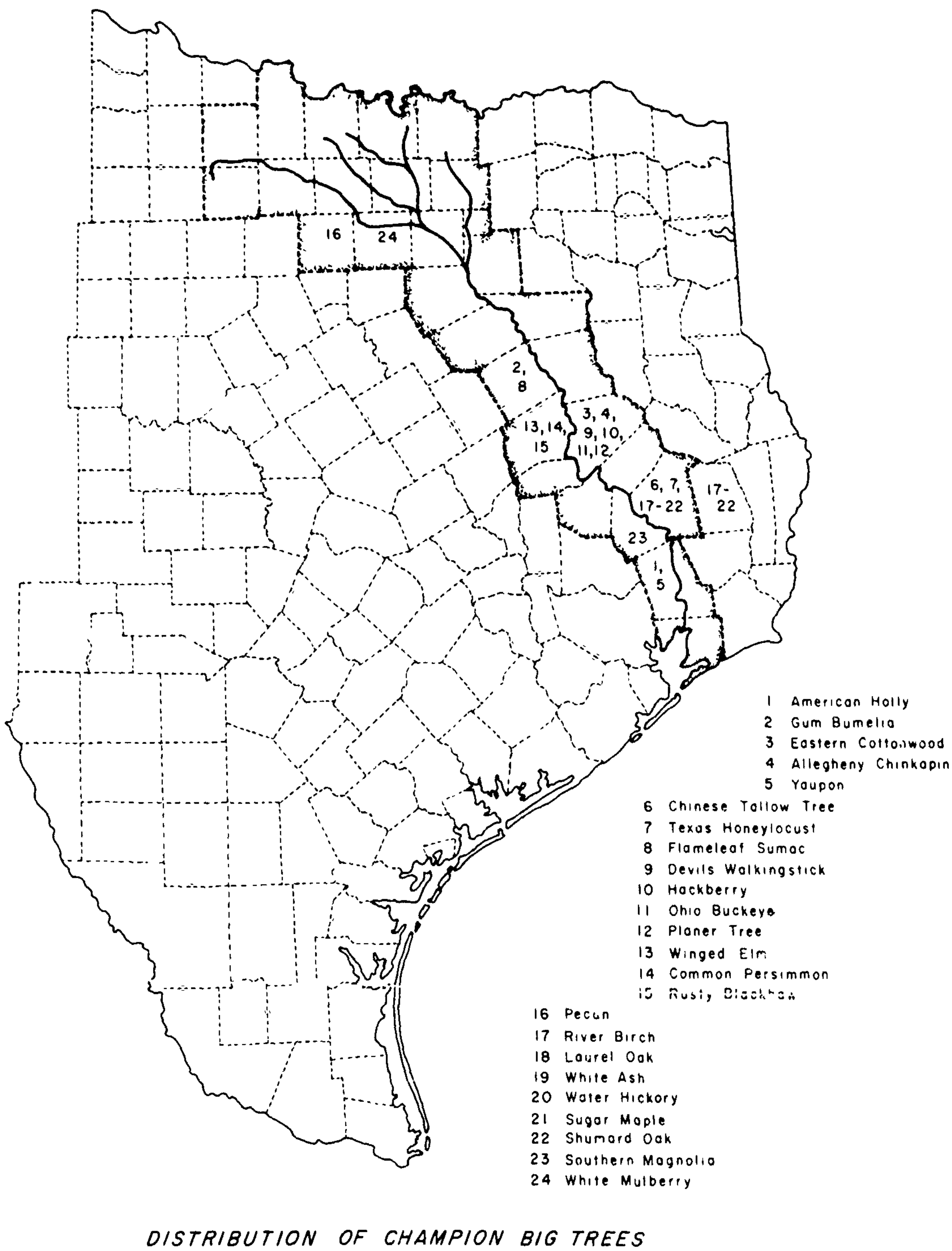

Figure 9. Distribution of National and State Champion Big Trees.

protection, while one (109) is located within a Park presumably on high ground. Of the remaining five (5), four (169, 21, 75 and 65) are on old or new homesteads located several miles from the Trinity River and probably on high ground. The last one (171) is, from the location, probably within the Trinity River bottom or very close to it; this famous tree is also a national champion and was measured in 1964:

> "The National Champion American Holly is located in Liberty County, about 4 miles west of Hardin. Follow Farm Road 1011 west from Hardin 1.6 miles, then follow Farm Road 1411 about 1.2 miles. The tree is about half a mile beyond the end of the pavement and about 75 feet southwest of road." (Texas Forest Service, 1970, p. 171)

NATIONAL AND STATE CHAMPION BIG TREES;
(an asterisk indicates location within a town or city).

Three Champion Big Trees occur within a mile of the Trinity River proper (Fig. 9).

National Champions:

1. American Holly - Liberty County (see Famous Trees).
2. Gum Bumelia - Freestone County; ca. 4 miles SE of Mt. Zion near Cook Lake.

State Champions:

3. Eastern Cottonwood - Houston County; ca. 2 miles SW of Smith, W. of Porter Springs.

Twenty-one Champion Big Trees occur within the counties of the study area (Fig. 9).

National Champions:

Houston County	: 4.	Allegheny Chinkapin
Liberty County	: 5.	Yaupon
Polk County	: 6.	Chinese Tallow Tree*
	7.	Texas Honeylocust

State Champions:

Freestone County :	8.	Flameleaf Sumac*
Houston County :	9.	Devils Walkingstick
	10.	Hackberry
	11.	Ohio Buckeye*
	12.	Planer Tree
Leon County :	13.	Winged Elm*
	14.	Common Persimmon
	15.	Rusty Blackhaw
Parker County :	16.	Pecan
Polk County :	17.	River Birch*
	18.	Laurel Oak
	19.	White Ash
	20.	Water Hickory
	21.	Sugar Maple
	22.	Shumard Oak
San Jacinto County:	23.	Southern Magnolia
Tarrant County :	24.	White Mulberry

Summary

Research reports pertinent to the Trinity River Basin are scattered and fragmentary throughout many publications. Generalizations on the vegetation are therefore based upon studies primarily outside of the study area. A brief summary of the vegetation zones along with appropriate ecological concepts are presented for the entire length of the Trinity River.

A discussion on endemics and a coding system for another type of evaluation are followed by a list of 65 Texas vascular endemics which have part or all of their range of distribution within the Trinity River study area. Sixteen of these vascular endemics are rare and endangered and their distribution mapped by counties. There are thirteen vascular endemics that are to be expected within the area which subsequent study will determine.

There are 319 vascular taxa which are listed as rare and the extent to which these actually occur still remains to be determined through future study. Of the 319, 18 taxa most directly threatened with extinction as enumerated by the Rare Plant Study Center (University of Texas at Austin)

are indicated.

Part of the region through which the Trinity River flows is an excellent area for fungi and bryophytes but relatively few taxa have actually been reported and thus their status is unknown.

The transplanting or relocation of rare and endemic plants is discussed with the feasibility of such a program for all plant groups. In essence, only a few taxa of the members of the plant kingdom would be potential transplants. The majority would not survive and therefore, preservation of habitats is imperative.

Plant fossils are listed along with counties and references of the reports.

Palynological studies have not been conducted within the study area but some have been made in adjacent counties within the same vegetation zones.

Trees of importance are divided into two categories, Famous Trees of Texas and Champion Big Trees (National and State). Of the ten trees of historical prominence within the designated counties, five are located within several miles of the Trinity River with one of the five a National Champion Big Tree (American Holly). There are two other Champion Big Trees within a mile of the Trinity River - Gum Bumelia (Freestone County) National Champion and Eastern Cottonwood (Houston County) State Champion. Twenty-one other Champion Big Trees occur within the county designation of the study area with five of these located within towns or cities.

Recommendations

It is apparent that additional study on the native flora of Texas is necessary to evaluate the endemics of the study area. It is recommended that biosystematics studies (including cytology, morphology, and controlled experiments) be made regarding endangered taxa with the study of Stebbins and Major (1965) as a guide towards a common objective. There are 13 vascular endemics that are to be expected within the study area and a future inventory would determine the extent of their range.

In regard to rare plants, recent work in East Texas has resulted in the addition of several taxa to the state flora which are as yet unpublished (oral communication - D.S. Correll). It is important that botanical surveys cover all of the seasons of the year for at least two years. Annuals may not appear if certain conditions are unfavorable; seeds of native plants have a low percentage of germination with only a few seeds germinating each year over a number of years. Thus, autecological studies of rare taxa should be made possibly in the same manner that the dominants were studied by Dyksterhuis (1948) coupled with biosystematic studies.

Vegetation zones, several of which are traversed by the Trinity River, should be studied in at least the detail which Dyksterhuis studied the Fort Worth Prairie (1946) and the Western Cross Timbers (1948). The research should cover several years duration for a proper interpretation.

Intensive collecting and curation of plants as herbarium specimens are recommended for future research and could be considered as a salvage operation prior to habitat destruction. If specimens are collected and stored in herbaria, they will always be available for future study. The oldest plant specimen in the SMU Herbarium was collected in 1791 at Monterrey, Mexico. With adequate curation, the specimens will last indefinitely.

Studies of lichens, bryophytes, algae, and fungi should also be undertaken because of a general lack of information. Lichens are being studied in some areas today for their role as plant indicators of pollution. It is imperative that inventories of these groups be made prior to any construction programs.

In general, complete inventories (including all groups within plant kingdom) are essential and from these studies, habitats that are unique could be distinguished. It is strongly recommended that habitats of endemics and rare plants, which cannot be duplicated by man, be preserved instead of attempting to transplant (especially cryptogams - mosses, liverworts, fungi, etc.) into an artificial environment as it would be economically unfeasible to try to duplicate particular environments. However, recommendations for habitat preservation cannot be made prior to adequate inventories and proper evaluation thereof.

Outline for Future Research

An organizational outline by subject matter (botanical disciplines) is presented. The results of these studies would then be synthesized with the zoological and abiotic data for the total ecological impact of the area.

Non-vascular plants:

- Algae - algologist
- Fungi - mycologist
- Mosses & Liverworts - bryologist

Vascular plants:

- Ferns and Seed plants - taxonomist
- Endemics and Rare plants - (endangered) - biosystematist

Vegetation - plant ecologist
Palynology - palynologist
Paleobotany - paleobotanist

An inventory of the non-vascular and vascular plants is essential for the foundation of any other botanical phase. Vegetational studies involving plant succession and studies on specific endemics are needed in addition to the inventory. The basic concept upon which this organizational outline is based is that you have to know what you are working with first and only then is one in a position to study the function (ecological niche) and other various facets.

Each of the categories listed would require specialists in that area of study. Personnel needed for an adequate inventory for the botanical phase consist of an algologist, mycologist, bryologist, and systematic botanist (taxonomist). The biosystematist and the plant ecologist would depend upon the others for locations and identifications in their studies and their report would be coordinated with the reports of the paleobotanist and palynologist.

It is regrettable in one sense that no single college or university in the state (Texas) has all of the faculty necessary for the completion of the study outlined. At the present time, there are only two major herbaria available in the state for accurate identifications and storage facilities of vascular plant specimens for the study area, the University of Texas at Austin and SMU.

One of the objectives for this type of organizational research would be to search for climax vegetation types representative of each zone as well as unique habitats. Only after such studies are made, can adequate decisions be made regarding wise land use, conservation, and preservation.

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CHAPTER III

ARCHAEOLOGICAL LITERATURE SURVEY

TRINITY RIVER BASIN

by

S. Alan Skinner
Research Archaeologist
Department of Anthropology

ARCHAEOLOGICAL LITERATURE SURVEY
TRINITY RIVER BASIN

A compilation and review of the archaeological literature of the Trinity River Basin was undertaken in order to provide a framework for evaluating the known archaeological resources within the area. In this way an overall synthesis of the the particular subject of interest, archaeology in this case, is prepared and can then be used to formulate additional in depth study which should be carried out in order to collect the data necessary for the preparation of an acceptable Statement of Environmental Impact.

The first step in the preparation of this study was the compilation of a comprehensive bibliography of those published and unpublished books, articles and manuscripts relating to the Trinity River Archaeology. This process had been started in response to a letter from General Parfitt to James V. Sciscenti prior to the initiation of this study. The second step was the abstracting of the sources that were available in public and private libraries both in Dallas and in Austin. This necessitated visits to the Texas Archeological Research Laboratory and the office of the State Archeologist in Austin. Copies of the Houston Archeological Society Newsletter was made available by that organization as were the records and library of the Texas Archeological Society.

The third step was the synthesizing of the known archaeology within natural environmental zones. When sites were plotted on maps in each of these zones it became obvious that there were many unknown areas and that site distributional data were only present within reservoir pool areas.

The last step was the preparation of models which are built upon the available information and predict what should be looked for during a comprehensive on-site evaluation of the resources in those areas that will be affected by construction. By following the research design provided herein the archaeological teams will be looking for data specifically relevant to an evaluation of the archaeological resources from a broad perspective rather than just in terms of the periods or other <u>single factor</u> evaluation as has been done in the past.

Evaluating archaeological resources is a new perspective from which today's literature can be viewed and in which past archaeological research can be viewed as being somewhat lacking in forethought and overview. Within the Trinity River Basin archaeology has been synonymous with salvage as conducted both by professionals and trained amateurs. This salvage has focused upon chronology building to the almost total exclusion of other interests. Consequently we can tentatively evaluate sites with regard to their period (s) of occupation but we know little or nothing about what the people who were living at a site were doing. There is no way to determine the importance of a site with regard to seasonal utilization of different plant and animal foods or to the density of a particular type of site within an area. Without this information each site has to be viewed as a unique example and consequently if affected by construction it should by definition be salvaged or preserved.

Particularly lacking from the published literature are the specific items listed below:

1) site situation with respect to the local terrain and to the topographic variation in the general area,
2) a typology of sites, eg. base camp, hunting camp, shell midden, stone quarry site, based on an assessment of the situation, the site deposit and the artifacts on the surface,
3) the distribution of sites with respect to time and to different activities and situations represented,
4) evaluation of the density of occupation during different maintenance activities,
5) determination of the natural environmental resources used at a site on the basis of excavated information.

These factors need to be determined before an adequate assessment can be prepared. They are absent from the record due to a lack of coordinated interdisciplinary programs and their collection will require the preparation of in depth research designs before field work is carried out.

Archaeological Overview

Archaeological research in Texas has generally focused upon the problems of developing a chronological framework and delimiting prehistoric culture areas. It is with these problems in mind that the majority of archaeological surveys and excavations have been concerned and as such, there is little discussion of the activities at a site or the relationship of one site to another even within a particular reservoir. Key tools, particularly projectile points and pottery, have been used as the foundation for the time control and the definition of culture areas throughout the state.

A broad chronological framework within which the area of Texas is ordered was presented in 1954 in the "Handbook for Texas Archeology" (Suhm, Krieger and Jelks 1954). Four stages were proposed to span the period from earliest occupation to the end of the ethnohistoric period. These stages are Paleo-Indian, Archaic, Neo-American and Historic. These periods, their time and way of life are briefly described below:

Paleo-Indian	9500 - 5500 B.C.	mammoth, bison hunting; seasonal movement; small bands composed of several families
Archaic	5500 B.C.- A.D.800	hunting of small game, gathering wild plants, seasonal movement; small bands composed of several families
Neo-American	A.D. 800-1600	hunting and gathering, marginal agriculture in same areas; tribal and confederacy groups
Historic	A.D. 1600-1800	introduction of horse and eventual extermination or removal of Indians

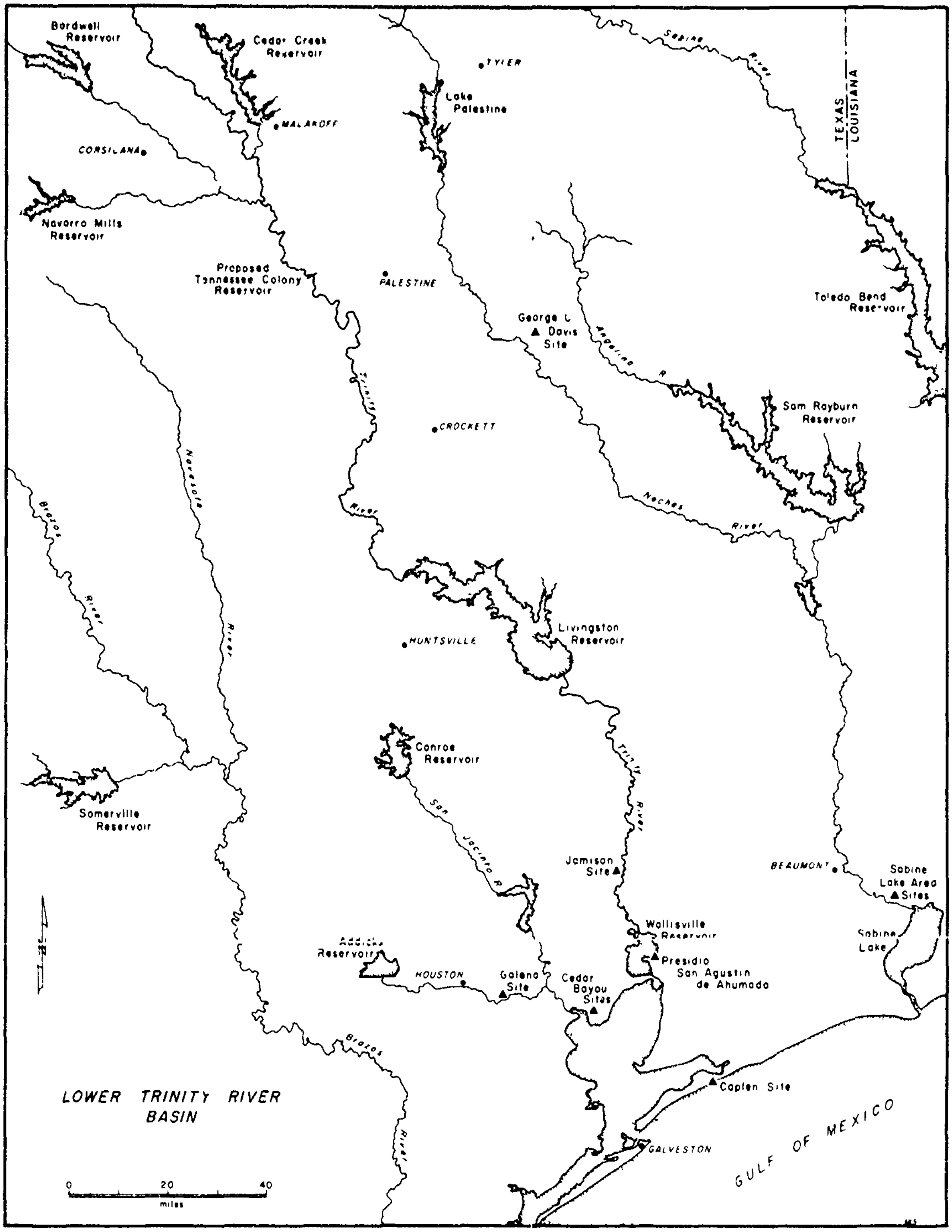

Figure 10. The Lower Trinity River Basin

Lower Trinity River

Recent archaeological research in the Galveston Bay area has been conducted by Rice University, the University of Texas, Texas State Building Commission, and the Houston Archeological Society. The majority of this work has been conducted as salvage programs, eg. Wallisville Reservoir, Addicks Dam Reservoir, the Caplen site and Cedar Bayou sites, although the Jamison site and the Fullen site were excavated by amateurs and students as problem-oriented studies. The Houston society is presently working at the Spanish Mission site of Nuestra Senora de La Luz (1756-1771) in Wallisville Reservoir.

Shell middens are the most common type of site known in the Texas Coast area. These sites range in size from small accumulations of trash and living refuse representing only a few day's occupation to large mounded deposits which contain evidence of several hundred years of occupation. Clam and oyster shells make up the midden mass and interspersed throughout are animal bones, chipped stone tools, pottery, and other artifacts used and discarded by the prehistoric occupants.

The majority of sites in Wallisville Reservoir are located on or in the Recent floodplain although sites are also found at the river edge of the first terrace. An undetermined number of sites were buried by river flooding and are under the present ground surface. Reconstruction of river movement within the floodplain can be substantiated by analysis of the locations of prehistoric camps through time. The present evidence suggests that the Lower Trinity River area was occupied continuously from the Early Archaic through the historic period and these people moved their encampments seasonally in response to changes in season and availability of food. The economy was primarily hunting and gathering during the entire period although it is possible that agriculture may have been practiced in the late prehistoric period particularly in the up-river sites such as Jamison.

This review of the archaeological literature from the Lower Trinity valley has tended to show that investigations, and therefore reported sites, are located at reservoirs, eg. Wallisville and Livingston. The river floodplain between these reservoirs and land outside the reservoir pool areas is virtually unknown in an archaeological sense. However on the basis of the available data, we can predict that prehistoric and historic sites occur along the Trinity River and that chances are good that certain sites will be destroyed as as result of river channelization. Consequently we must recommend that systematic archaeological site survey of the river floodplain be conducted in order to evaluate the importance of archaeological sites which will be affected by channelization.

The prehistoric sites at Lake Livingston are quite different from those recorded at Wallisville Reservoir. These differences are not clearly reflected by the specific types of pottery and chipped stone tools and both areas were occupied continuously from the Late Archaic period through the Neo-American period (ca. 2000 B.C. - A.D. 1500). It is suggested that the differences in location and site type reflect differences in topography, geology, soils, water availability, plant and animal communities to which the prehistoric people adapted in order to subsist in the respective areas. Therefore, I have briefly outlined three distinct environmental zones in this area using data from the natural and physical sciences and applying them to the physiographic provinces of Texas (Fenneman 1938). We expect that the prehistoric occupants of each area adapted to the local resources. By formulating these zones before site survey is begun we have provided a basic model of environmental adaptation against which prehistoric evidence can be checked. In this way the archaeologist working with Federal agencies will be able to add a valuable imput into the preparation of an Environmental Impact Statement. The model proposed below may be reworked after the analysis of survey data and the archaeologist will be then able to predict for the Corps which sites should be excavated and why each should be dug in order to get a representative sample of the archaeological remains that will be affected.

The environmental zones discussed below are based on information contained in "Physiography of Eastern United States" (Fenneman 1938). Three zones cross-cut the area of the Lower Trinity River and these are the 1) Coastal Prairie, 2) Pine Flats, and 3) East Texas Timber Belt/Hockley Scarp. A description of each area was prepared by incorporating information on the geology (Sellards, Adkins and Plummer 1932, Aten 1966), soils (Carter 1931), vegetation (Braun 1950), fauna (Blair 1950), topography (U.S.G.S. maps) and other pertinent variables into a general but coherent description. Each of the areas can be viewed as a unit although they do intergrade and have frequently been treated as representing one general "coastal" area. Treatment as a single area does not, however, help us to interpret the variation in the prehistoric occupations that have been described.

Uniformity of the area is reflected in the facts that the equal annual temperature is 68° and the equal annual rainfall is 45". Elevation ranges from sea level to about 250' and much of the area is a broad flat coastal plain.

The first of the three zones is the Coastal Prairie which extends from the mouth of the Trinity River at Galveston Bay inland to about Liberty, Texas. This is a distance of about 20 miles. The Coastal Prairie is a low, flat featureless plain which is covered by hardwoods and pines. Grasses and sedges constitute the cover found in the swamps, sloughs and floodplain of the river. The river floods periodically and inundates the bottomland. A narrow band of Trinity clay parallels the river and the major soils of the area are the dark-colored soils of the Lake Charles series. These soils are derived from marl decomposition and typically are clay. Their development is typified by a heavy grass cover, slow drainage and high moisture content. Small areas of Edna, Hockley and Katy soils also occur in the area.

Animal resources include Rangia clams, oysters, fish, crustaceous (crabs) turtles, alligators, deer and rabbits as well as certain seasonal birds. Seafoods are also present. The terrain is smooth and low, there being little more than 50' in maximum elevation present anywhere in the area.

It is proposed that the Coastal Prairie was occupied by prehistoric peoples whose economy is directly linked to the seasonal availability of natural resources (Aten 1967; Campbell 1967; OBrien 1971) and is expressed in a restricted wandering community pattern (Shafer 1964; Ambler 1970). If this is true then we would expect that:

1) sites will be located in specific spots in order to maximize the collection of a limited type of food resource;
2) repeated occupation of seasonal or food-specific sites occurred;

3) sites located on the Beaumont terrace were occupied during periods when the river floodplain was inundated;
4) Variation in site size and in tool/artifact assemblage will reflect seasonality and relative availability of resources and that a single "base camp" will not be found;
5) occupation sites of those people adapted to the Coastal Prairie will be found on the Beaumont terrace, on the Galveston Bay coast, and in the Trinity River floodplain.

The second zone is the Pine Flats which extends upstream from Liberty, Texas for thirty miles to just north of the Liberty County Polk/San Jacinto County boundary. The terrain is generally low and featureless with elevation ranging from 25 to 150 feet. The higher elevations occur primarily in the northern third of the zone.

Swamps and marshes parallel the river and contrast sharply with the drier better drained upland. The drainage pattern extends only a short distance on either side of the river. Runoff is rapid and the bottomland is frequently flooded. Pines and some oaks dominate the upland and are rooted in Segno-Caddo soils. Lisse and Largarto formations underlie the flat terrain. There is an abundance and variety of upland and riverine fauna.

It is proposed that the Pine Flats zone was occupied by prehistoric peoples with a hunting/gathering economy (Aten 1967) and reflected in a central based wanderer community pattern. If this is correct then we would expect that:

1) base camps will be located on the river terraces above seasonal flood level and that these sites will be the largest in area and have the widest variety of tools and other artifacts;
2) seasonal gathering camps will be found in the river floodplain adjacent to the river or its tributaries;
3) seasonal hunting/gathering camps will be found on the upland away from the river.

The third zone is the East Texas Timber Belt/Hockley Scarp and extends from the southern end of San Jacinto and Polk Counties northwestward about 40 miles to the vicinity of

Trinity, Texas where a geological feature known as the Kisotchie Scarp occurs. The Trinity River floodplain is narrower than on the lowland and is more definately confined by the faintly rolling upland which is based on the Catahuela fm. and the underlying Eocene age Jackson group.

The elevation ranges from about 15C at the base of the Hockley Scarp upwards to about 250' msl. There are numerous spring fed streams and the drainage pattern of the river begins to include a wider area on either side of the river. Luflin-Susquenhanna soils cover the ground and are anchored in place by the heavy growth of the oak-pine forest, a southward extension of the East Texas Timber Belt. Spanish moss and palmetto are abundant in the area and there is a diversity of animals.

It is proposed that the East Texas Timber Belt/Hockley Scarp was occupied by prehistoric people who practiced a seasonal hunting/gathering economy (Nunley 1963; McClurken 1968) and whose settlement pattern can be described as central-based wanderer. If this is correct then we would expect that:

1) base camps will be located on the river terraces above seasonal flood level and that these sites will be the largest in area and have the widest variety of tools and other artifacts;
2) seasonal gathering camps will be found in the river floodplain adjacent to the river or its tributaries;
3) seasonal hunting/gathering camps will be found on the upland away from the river.

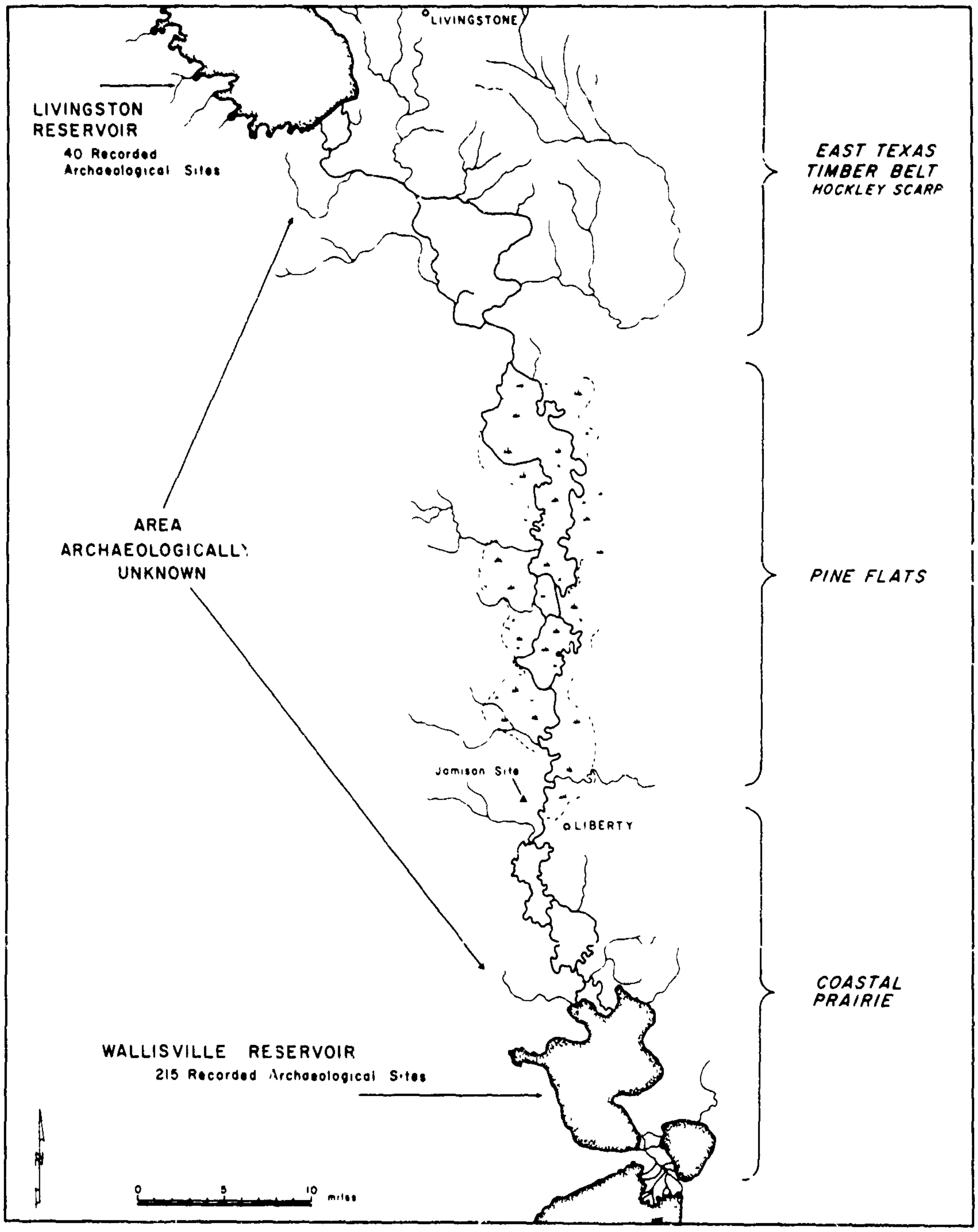

Figure 11. Location of recoraed sites in the Lower Trinity Basin.

Literature Abstracts

Ambler, J. Richard
1967 Three Prehistoric Sites Near Cedar Bayou, Galveston Bay Area. Texas State Building Commission, Archeological Report, No. 8. Austin.

Two weeks of salvage excavations near Cedar Bayou were sponsored by the State Building Commission in 1967. Excavation was limited and conducted in three small, prehistoric camp middens. Although shallow in depth, there was evidence of three recognizably different periods of occupation. The first is a pre-pottery period dated before A.D. 150. The second period dates between A.D. 150-500 and is recognized by the presence of sand tempered pottery. Sherd temper and surface decoration mark the third period which begins after A.D. 500. Evidence of historic occupation was not recorded during excavation.

Ambler, J. Richard
1970 Additional Archeological Survey of the Wallisville Reservoir Area, Southeast Texas. Texas Archeological Salvage Project Survey Report, No. 6. Austin.

Initial salvage excavations were begun at Wallisville Reservoir in 1966 and at that time it became apparent that additional archaeological survey was necessary. The survey was conducted in 1968 and 95 additional sites were located. Moreover the author suggests on the basis of available data that a hundred or more sites lie buried under the Recent alluvium.

Ambler proposes a seven period chronology for the Wallisville/Cedar Bayou area based on the survey and excavation data. The chronology spans the period from 300 B.C. to the Historic period and is based on stratigraphic superposition and radiocarbon dates.

period	time
Historic	
Galveston Bay Phase	A.D. 1100 - 1700
Early Galveston Bay Phase	A.D. 800 - 1000
Beginning Galveston Bay Phase	
Lost River Phase	A.D. 100 - 500
Archaic	
Early Archaic	

Aten, L. E.

1965 Five Crania from the Jamaica Beach Site (41 GV 5), Galveston County, Texas. Bulletin of the Texas Archeological Society, Vol. 36, pp. 153-162. Austin.

The Jamaica Beach site was excavated by the Houston Archeological Society. Seventeen flexed burials were excavated from burial area 20 feet square. A radiocarbon date of 490 $\pm$ 100 B.P. (A.D. 1460) was obtained from shell associated with one skeleton and it is suggested that the associated campsite and the burial area may date from the early historic period. Cranial measurements and morphological observations are presented.

Aten, Lawrence E.

1966 Late Quaternary Alluvial History of the Lower Trinity River, Texas: A Preliminary Report. Appendix I in An Archeological Survey of Wallisville Reservoir, Cambers County, Texas, by H. J. Shafer, Texas Archeological Salvage Project, Survey Report, No. 2, pp. 39-43. Austin.

A detailed summary of the Quaternary terrace system and the recent geologic history is presented. It is suggested that the Deweyville surface may be as recent as 5-7000 B.P. and that early Indian sites should be expected. The modern alluvial-deltaic plain complex represents the period from 5000 B.P. to the present and it was during this period, sometime between 3-5000 years ago, that the present sea level was attained. Indian sites can be used to trace the movement of the river in the recent period and therefore can serve as an independent check upon independent geologic reconstruction.

Aten, Lawrence E.

1967 Excavations at the Jamison Site (41 LB 2), Liberty County, Texas. Houston Archeological Society, Report No. 1. Houston.

The Jamison site is stratified midden deposit containing three separate horizons. The earliest horizon is preceramic (Late Archaic) and is subdivided into two zones separated by a layer of sterile sand. Expanding stem dart points dominate this horizon. The second occupation is represented by the appearance of sandy paste pottery and a shift toward more contracting stem dart points. The latest horizon is signaled by the adoption of incised decoration and clay tempered pottery, as well as an increase in the numbers of arrow points and a decrease in dart point numbers. Contact with prehistoric Caddoan peoples occurred during the last horizon. Although pottery and projectile points occur at the Jamison site, there is no evidence of grinding tools or other tools or food remains attributable to gathering activities. Therefore it is suggested that the Jamison site represents a seasonal or activity-specific site and not a permanent year-round base camp.

Campbell, T. N.
1967 Archeological Investigations at the Caplen Site, Galveston County, Texas. Texas Journal of Science, Vol. 9, No. 4, pp. 448-471.

The Caplen site is a small knoll (15 meters in diameter) from which a University of Texas field party excavated 66 burials including at least 80 individual skeletons. This appears to represent a burial site and the location of the village where these people lived is unknown. The site is tentatively dated to the Galveston Bay Focus and possibly the early historic period.

Hsu, Dick Ping
1969 The Arthur Patterson Site: A Mid-Nineteenth Century Site, San Jacinto County, Texas. Texas State Building Commission and Texas Water Development Board, Archeological Survey Report, No. 5. Austin.

The Arthur Patterson site is an historic Indian burial site located three and half miles west of the Trinity River in San Jacinto County. Three burials were recovered during salvage excavation at the site in 1969. Three additional disturbed burial pits were also located. All artifacts found with the burials were of European manufacture and date sometime between the 1840's and the 1870's. The burials are probably that of Alabama-Coushatta Indians.

O'Brien, Michael
1971 The Fullen Site, 41 HR 82. Bulletin of the Texas Archeological Society, Vol. 42, pp. 335-365. Dallas.

The Fullen site is located on the east bank of Middle Bayou southeast of Houston. This is a shell midden which is about 18" thick. Pottery is the most common artifact class and was found in abundance to about 12" below the surface. The site is interpreted as a seasonally occupied camp.

Shafer, Harry J.
1966 An Archeological Survey of Wallisville Reservoir, Chambers County, Texas. Texas Archeological Salvage Project, Survey Report, No. 2. Austin.

Forty seven archaeological sites were recorded during the initial survey of Wallisville Reservoir. The sites are primarily shell middens, ie., concentrations of oyster, salt water shellfish and Rangia claim shells mixed with other man-made artifacts. Sites are generally located on abandoned levees and date less than a maximum of 5000 years before present. Four occupation periods are represented: preceramic, early ceramic, Galveston Bay Focus and historic.

Tunnell, Curtis D. and J. Richard Ambler
1967 Archeological Excavations at Presidio San Agustin de Ahumada. Texas State Building Commission, Archeological Report, No. 6. Austin.

The Spanish established the Presidio San Agustin de Ahumada on the lower Trinity River in 1756. In 1766 the presidio was moved to a new location about a quarter of a league east of the original site and in 1771 the presidio and its mission were abandoned. The presidio had been built in order to guard against French incursion but the environmental conditions at the presidio were not favorable to the Spanish.

The location of the second presidio was discovered in 1966 and salvage excavations were conducted at that time. However, most of the site has been destroyed in the 1950's by the removal of fill which was used for construction of Interstate Highway 10. Identification of the location is based on the La Fora map of 1767 and the artifactual remains recovered during excavation. Presidio San Agustin de Ahumada is the first Spanish settlement in east Texas that has been definitely located and excavated. The importance of this site and other similar sites is due to their rarity and the significant part they played in early Texas history.

Wheat, Joe Ben

1953 An Archeological Survey of the Addicks Dam Basin, Southeast Texas. Smithsonian Institution, Bureau of American Ethnology, Bulletin No. 154, River Basin Surveys Papers, No. 4, Pt. 1. Washington.

Nine prehistoric sites were recorded and four were tested in conjunction with construction of Addicks Dam. Each site is located on a low knoll of sand or clay and all are middens containing camp refuse. Houses were not found although seven human burials were uncovered. The stratification points to a three horizon sequence which may be underlaid by Paleo-Indian occupation at the Doering site. The first horizon (period) is characterized by expanding stem dart points, the second by pottery and contracting stem dart points and the third by arrow points and pottery.

Additional Houston Area Bibliography

Aten, Lawrence E.

1964 Cranium from Addicks Dam Reservoir. Newsletter of the Houston Archeological Society, No. 12.

1965 Reconnaissance in the Lower Trinity River Alluvial Plain. Newsletter of the Houston Archeological Society, No. 12, pp. 1-3. Houston

1967 Two Unique Beads from the Dayton, Texas Area. Newsletter of the Houston Archeological Society, No. 21, pp. 4-5. Houston.

1969 A Preliminary Report on the Development of a Ceramic Chronology for the Sabine Lake Area of Texas and Louisiana. Bulletin of the Texas Archeological Society, Vol. 40, pp. 241-257. Dallas.

Atkinson, M. Jourdan

1966 The Ancient People of Lake Suprise. 36th International Congress of Americanists, pg. 321. Sevilla.

Atwood, W. L.

1952 Three Sites near Baytown. Bulletin of the Texas Archeological and Paleontological Society 23: 303-309.

1961 Baytown Prehistoric Mounds. The Houston Archeologist, No. 4, pg. 3. Houston.

1962 Prehistoric Levees. The Newsletter of the Houston Archeological Society, No. 9, pg. e. Houston.

Bailey, Gordon

1960 The W. T. Jamison Site - 41-LB-2. The Houston Archeologist, No. 3, pp. 2-3. Houston.

Bailey, G. F.
1961 A Point from Peggy Lake. The Houston Archeologist, No. 4, pp. 2-2A. Houston

Bollich, Charles N. and Burney McClurkan
1967 An Informal Statement of Business at the First Annual Atakapa Conference. Texas Archeology, Vol. 11, No. 1, pp. 16-19. Dallas.

Chandler, Charles K.
1967 A Report of Test Excavations at Site 41MQ14: A Small Terrace Site in Montgomery County, Texas. Unpublished ms.

Chandler, C. K.
1967 Status Report on HAS Week-end Dig - 41MQ14. Newsletter of the Houston Archeological Society, No. 21, pp. 3-4. Houston.

Dieckman, John J.
1960 Notes on Houston Area Archeology. Houston Geological Society Bulletin.

Douglas, James
1903 Human Bones Found Near Galveston, a Letter Communicated by Mr. James Douglas. Bulletin of the American Geographical Society of New York, Vol. 35, No. 5, pp. 548-549.

Duke, Alan R.
1962 Preliminary Report on the Damek Site, Liberty County, Texas. The Newsletter of the Houston Archeological Society, No. 8, pg. 4. Houston.

1967 Houston Lighting and Power Co. Site No. 1 - (41HR72). Newsletter of the Houston Archeological Society, No. 20, pg. 5. Houston.

1969 Boys School Site, Clear Lake, Harris County. Newsletter of the Houston Archeological Society, No. 29, pp. 2-4. Houston.

1970 Analysis of Ceramic and Bone Artifacts from 41HR73 (Surface Collection). Newsletter of the

Houston Archeological Society, No. 34, pp. 3-4. Houston.

1970 Boy's School Site - Clear Lake. Newsletter of the Houston Archeological Society, No. 32, pg. 2. Houston.

1970 Clear Lake City Salvage Project. Newsletter of the Houston Archeological Society, No. 32, pg. 2. Houston.

1970 Indian Artists of the Gulf Coast. Newleter of the Houston Archeological Society, No. 31, pp. 3-6. Houston.

1970 Progress Report on the Evaluation of the Archeological Potential of 41CH57 (Presidio San Agustin de Ahumada). Newsletter of the Houston Archeological Society, No. 31, pp. 2-3. Houston.

Fullen, W. L.

1965 Berry Gully Site - Harris County, Texas. Newsletter of the Houston Archeological Society, No. 12, pg. 4. Houston.

Hartman, Danny

1961 A Large Pot. The Newsletter of the Houston Archaeological Society, No. 5, pp. 3-4. Houston.

Malone, James

1969 Report on the Excavation and Analysis of a Prehistoric Site in Liberty County, Texas: The Price Daniels Site, 41 LB 3. MA Thesis at the University of Texas at Austin.

Mayhall, Mildred P.

1939 The Indians of Texas: The Alakapa, the Karankawa, the Tonkawa. Unpublished PhD. dissertation, University of Texas library. Austin.

Mewhinney, H.

1961 Montgomery County - Hosteter Creek Number 1. The Newsletter of the Houston Archaeological Society, No. 5, pp. 5-6. Houston.

Neyland, Wayne B. and R. B. Worthington
1962 The Probable Function of Certain Perforated Shells from the Galveston Bay Area of Texas. The Newsletter of the Houston Archeological Society, No. 8, pp. 2-3. Houston.

Neyland, Wayne B. and Lawrence E. Aten
1971 Interior Incising in Coastal Southeast Texas: Its Presence and Significance. Newsletter of the Houston Archeological Society, No. 35, pp. 6-9. Houston.

Pearce, J. E.
1932 The Present Status of Texas Archeology. Bulletin of the Texas Archeological and Paleontological Society, Vol. 4, pp. 44-54. Abilene.

1932b The Archeology of East Texas. American Anthropologist, Vol. 34, No. 4, pp. 670-687.

Pohl, E. F.
1937 Archaeology on the Texas Coast. National Archaeological News, Vol. 1 (7): 22-23.

Potter, Wendell H.
1930 Ornamentation of the Pottery of the Texas Coastal Tribes. Bulletin of the Texas Archeological and Paleontological Society, Vol. 2.

Ring, E. Raymond
1963 Opened by Accident. The Newsletter of the Houston Archeological Society, No. 10.

Stevenson, Robert W.
1960 Nymph Point No. 1. The Houston Archeologist, No. 3, pg. 4. Houston.

Suhm, Dee Ann, Alex D. Krieger and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. Bulletin of the Texas Archeological Society, Vol. 25. Austin.

Wheat, Joe Ben
1947 Archaeological Survey of the Addicks Basin: A Preliminary Report. Bulletin of the Texas

Archeological and Paleontological Society, Vol. 18, pp. 143-145. Lubbock.

Woodbury, George
1937 Notes on Some Skeletal Remains of Texas. University of Texas Publications, No. 3734; Anthropological Papers, Vol. 1, No. 5.

Woolsey, A. M.
1932 Explorations in Chambers County, 1932. Manuscript on file at the Texas Archeological Research Laboratory, Balcones Research Center, The University of Texas.

Worthington, R. B.
1961 Some Immediate Problems of the Upper Texas Gulf Coast. The Newsletter of the Houston Archeological Society, No. 6, pp. 1-3. Houston.

The Middle Trinity River

The Middle Trinity, the area from Tennessee Colony Reservoir to Livingston Reservoir is not represented by any Paleo-Indian or Archaic Stage sites. It is crossed by the Caddoan Alto Focus which is centered at the George C. Davis site (Newell and Krieger 1949) and is adjacent to the Frankston Focus which is located along the Upper Neches River. Nothing was known of the area during the Historic Stage.

In short, virtually nothing was known about the area prior to 1954 and subsequent to that period, no major site surveys or excavations have been carried out within the area. Salvage programs have been conducted to the north at Cedar Creek Reservoir, to the west at Bardwell and Navarro Mills Reservoirs, to the east at Lake Palestine Reservoir, to the south at Livingston Reservoir and to the southwest at Conroe and Somerville Reservoirs. All this work was done as part of the National Park Service funded Interagency Salvage Program. The information collected as part of these programs is presented below in the form of an annotated bibliography. The information is summarized after the bibliography and recommendations are presented for additional work.

Ethnohistory

Newcomb, W. W., Jr.
1961 The Indians of Texas, from Prehistoric to Modern Times. University of Texas Press, Austin.

Prior to 1800, the Atakapan group included three tribes who lived along the Trinity River from Galveston Bay to about the area of Tennessee Colony Reservoir. The ethnohistory of this area is poorly known because it is peripheral to the more highly developed Caddoan area of east Texas and to the lack of continuous Anglo contact during the early historic period.

The Akokisas "river people" lived along the lower Trinity and in the Galveston Bay area. Agriculture was impossible in this area and consequently the people subsisted by hunting and gathering. In the spring and summer, small family groups lived together along the coast. In the fall and winter, they moved inland and congregated in larger groups. Hunting was of considerable importance at this time.

The Bidais and Deadoses tribes lived upriver from the Akokisas and were more closely related to the Caddo. Although farming was carried out (corn was the principal crop) hunting and gathering were still an important means of supplementing their diet.

Sketchy historical documentation and limited ethnohistoric studies of the available data do not allow for an adequate description of these three tribes. It is possible to suggest that there is a contrast in subsistence patterns between the farming Bidais/Deadoses and the hunting/gathering Akokisas. This is in part related to the environmental resources and is probably reflected in the location and organization of their settlements.

Swanton, John R.
1942 Source Material on the History and Ethnology of the Caddo Indians. Smithsonian Institution, Bureau of American Ethnology, Bulletin 132. Washington.

This major reference on Caddo ethnohistory mentions the Trinity only in passing with reference to western movement of the Caddo.

Swanton, John R.
1946 The Indians of the Southeastern United States. Smithsonian Institution, Bureau of American Ethnology, Bulletin 137. Washington.

A brief summary of the ethnohistory of the Akokisa, Bidai, Deadose is included in this book.

Sjoberg, Andree F.
1951 The Bidai Indians of Southeastern Texas. Southwestern Journal of Anthropology, Vol. 7, No. 4, pp. 391-400. Albuquerque.

The only detailed description of the Bidai.

Literature Abstracts

Cedar Creek Reservoir

Davis, W. A.
1961 Archeological Survey and Appraisal of Cedar Creek Reservoir, Henderson and Kaufman Counties, Texas. Report sumbitted to the National Park Service by the Texas Archeological Salvage Project.

Thirty prehistoric archaeological sites are recorded. Sites are generally small in area (rarely 100 meters in diameter) and have a shallow deposit (usually less than 1 meter). Late Archaic (lithic) and Neo-American (ceramic) sites are represented. The Neo-American occupation is considered to be a mixture of traits from the Wylie Focus (East Fork of the Trinity) and the Caddoan area to the east.

Story, Dee Ann
1965 The Archeology of Cedar Creek Reservoir, Henderson and Kaufman Counties, Texas. Bulletin of the Texas Archeological Society, Vol. 36, pp. 163-257. Austin.

The results of excavation at three prehistoric sites are presented. The sites are middens which were less than 2.5' deep and generally contained no occupation features. Burned clay possibly from an earth-covered house was noted at one site. All three sites are interpreted as the locations of repeated intermittent visits which occurred over a considerable period of time. A Paleo-Indian and Middle Archaic occupation are represented at the Wild Bull site only, while Late Archaic and Neo-American are represented at each site.

Bardwell Reservoir

Shafer, Harry J.
1964 An Appraisal of the Archeological Resources of Bardwell Reservoir, Ellis County, Texas. Mimeographed report submitted to the National Park Service by the Texas Archeological Salvage Project, The University of Texas. Austin.

The archaeological survey of Bardwell Reservoir recorded 15 prehistoric sites. The sites tend to have small shallow midden deposits. Archaic and Neo-American occupations are represented.

Sorrow, William M.
1966 The Pecan Springs Site, Bardwell Reservoir, Texas. Papers of the Texas Archeological Salvage Project, No. 10. Austin.

The Pecan Springs site is located within Bardwell Reservoir on Waxahachie Creek. During excavation, 7 hearths, 3 human burials, 2 pits and 3 small areas of prehistoric refuse were uncovered. The presence of clay daub suggests that some form of earth-covered house was once present although post holes were not found. The kind and variety of tools suggests that this may have been a base camp which was occupied sporadically during the Late Archaic and Neo-American periods.

Navarro Mills Reservoir

Duffield, Lathel F.
1960 Survey and Appraisal of the Archeological Resources of Navarro Mills Reservoir, Navarro and Hill Counties, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

Nineteen small, shallow archaeological sites were recorded. Occupation ranges from Paleo-Indian through Early and Late Archaic, Neo-American and Historic periods.

Bryan, Frank
1937 A Preliminary Report on the Archeology of Western Navarro County and Some Camp Sites in Hill and McLennan Counties. Central Texas Archeologist, No. 3, pp. 70-79. Waco.

Describes sites along Richland Creek and in the Jester-Pursley area of Navarro County.

Duffield, Lathel F.
1963 The Strawn Creek Site, A Mixed Archaic and Neo-American Site at Navarro Mills Reservoir, Navarro County, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

This is a small oval midden, 50 x 20', excavated as part of the salvage program. The site was occupied during the Late Archaic/Neo-American periods but due to disturbance the vertical stratification is inconsequential. The midden contained 8 human burials. Based on the number and type of tools, it is suggested that it was a hunting camp.

Upper Neches River

Johnson, Leroy, Jr.
1961 An Archeological Survey of Blackburn Crossing Reservoir on the Upper Neches River. Bulletin of the Texas Archeological Society, Vol. 31, pp. 213-238. Austin.

Thirty-five prehistoric sites were located by this archaeological survey. These include 1 small Late Archaic site and 34 Neo-American sites. Most of the pottery bearing Neo-American sites are dated between A.D. 1200-1600 and assigned to the Frankston Focus.

Skinner, S. Alan
1971 Historic Archaeology of the Neches Saline, Smith County, Texas. Texas Historical Survey Committee Archeological Reports, in Press.

The Neches Saline is the location of a commercial salt manufacturing operation which was in business during the period 1820-1870. During the Civil War, salt was mass produced at the saline in order to supply the Trans-Mississippi Department of the Confederate States of America. Ten furnaces were located and the Emerald Bay site was excavated as part of the salvage program.

Anderson, Keith M.
1971 Archeological Resources of Lake Palestine, Texas. Report submitted to the National Park Service by Southern Methodist University.

Archaeological survey of the reservoir enlargement recorded 98 prehistoric sites. A small number of these are Middle Archaic hunting camps. Eighty-five sites have Caddoan ceramics. One site cluster west of the river appears to be an Alto Focus hamlet. The remaining sites have Frankston Focus ceramics and include a number of permanent village locations. The interpretive model is based on the ethnographic description of the Hasinai Caddo.

Newell, H. Perry and Alex D. Krieger
1949 The George C. Davis Site, Cherokee County, Texas. Society for American Archaeology, Memoir, No. 14. Menasha.

The George C. Davis site is a large Alto Focus Caddoan village which includes 3 man-made earthen mounds and an extensive occupation area in which many houses were located. The site appears to be of particular importance to the prehistory of the Neches River. Excavation by the W.P.A. was concentrated at Mound A and in the village adjacent to this mound.

Story, Dee Ann
1969 Current Research: George C. Davis site, Texas. Southeastern Archaeological Conference Newsletter, Vol. 13, pp. 25-32. Morgantown.

The results of recent excavations at Mounds B and C are discussed. Archaeological survey recorded 43 sites in the surrounding area. All of these sites are Late Archaic or post-Alto Focus in date and suggests that the Davis site represents a population concentration that did not occur before or after that time. This work was sponsored by the National Science Foundation and the office of the Texas State Archeologist.

Livingston Reservoir

Nunley, John P.
1963 Appraisal of the Archeological Resources of Livingston Reservoir, Polk, San Jacinto, Trinity, and Walker Counties, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

After review of the W.P.A. excavations at the Ellis and Matthews sites, a brief description was presented of the 40 prehistoric sites recorded by the survey. All but one (41SJ9) are open occupation sites which include small temporary camps and larger village sites. Occupation is attributed to the Late Archaic and Neo-American periods.

McClurkan, Burney B.
1968 Livingston Reservoir, 1965-66: Late Archaic and Neo-American Occupations. Papers of the Texas Archeological Salvage Project, No. 12. Austin.

Six prehistoric sites were excavated by the Texas Archeological Salvage Project as part of the Inter-Agency salvage program. The sites are small in area, largest is 1000 x 100', and relatively shallow. Each site, except for the Jones Hill site, is a midden deposit which contains prehistoric remains (pottery fragments, stone projectile points and tools, other broken and discarded remains). No occupation features were noted and the artifact samples were small. Eight firepits, 3 adult burials and 2 child cremations were recovered at Jones Hill.

Most of the sites appear to have been occupied intermittently, possibly on a seasonal basis. The Jones Hill site may represent a year-round occupied base camp.

On the basis of vertical stratigraphy and from comparison with information from adjacent areas, 2 major occupation periods are delineated. The earlier Late Archaic is characterized by contracting stem dart points and sand tempered pottery. The later Neo-American period is characterized by decorated non-sand tempered pottery and arrowpoints. Together these represent a 2000 year period from

500 B.C. to A.D. 1500; the Neo-American period began about A.D. 800 if radio-carbon dates from Jones Hill are reliable.

The Archaic occupation is related to the southern section of the La Harpe Aspect and there is evidence of strong influence from the Caddoan area during the Neo-American period. McClurkan considers that the entire occupation represents a continuous in-place development which evolved into the Atakapan tribe prior to the historic period.

Conroe (Honea) Reservoir

Shafer, H. J.
1966 Archeological Surveys of Honea, Pat Mayse and Halsell Reservoirs, Texas. Texas Archeological Salvage Project Survey Reports, No. 1. Austin.

Thirty-four prehistoric sites were recorded. The majority are Neo-American in age.

Shafer, H. J.
1968 Archeological Investigations in the San Jacinto River Basin, Montgomery County, Texas. Papers of the Texas Archeological Salvage Project, No. 13. Austin.

Three sites were excavated within Conroe Reservoir. Each of the sites is an occupation midden. The midden accumulation of a living area was uncovered at 41MQ6. Archaic and Neo-American periods are represented. The Archaic occupation is linked to the La Harpe Aspect and pottery from the Neo-American period shows stylistic evidence of contact with peoples in the Caddoan area of east Texas, to the Galveston Bay area and to the Rockport area.

Somerville Reservoir

Honea, Kenneth H.
1961 Appraisal of the Archeological Resources of Somerville Reservoir, Lee, Washington, and

Burleson Counties, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

Twenty-nine sites are reported. All are temporary campsites of the Archaic and Neo-American periods, some possible Paleo-Indian occupation is represented. Cultural affiliations are with central Texas.

Peterson, Frederick A.
1965 The Erwin's Bridge Site at Somerville Reservoir, Burleson County, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

Excavation of the Erwin's Bridge site revealed a disturbed deposit which had no clear cut natural or cultural stratigraphy.

Summary

The Tennessee Colony Reservoir-Livingston Reservoir section of the Trinity River is an area that can be described as archaeologically unknown. This lack of information is the result of a number of factors which include the location of already constructed reservoirs, and the focus upon defining archaeological culture areas rather than local cultures. Paramont among these factors is the failure of research organizations to focus upon the natural and cultural ecology within a natural area such as the Trinity River Basin.

During the past 15 years, salvage archaeological site surveys and excavations have circumscribed the Tennessee Colony-Livingston Reservoir area. Consequently, we can make predictions about the periods of prehistoric occupation and upon the types of archaeological sites expectable within the channel and reservoir areas.

Evidence of occupation exists for the entire prehistoric time sequence from Paleo-Indian to the Historic period. Scattered finds of Clovis and Folsom points attest to occupation by peoples who are generally associated with the hunting of now-extinct big game animals, such as mammoth and bison. No in-place Paleo-Indian site has as yet been scientifically excavated and reported, however, the previously mentioned surface finds and information on the Pleistocene geology of the area suggest that such sites are present. Paleo-Indian habitation camps and kill sites tend to be found on the first and second terraces adjacent to the river. However, bison kill sites have been found exposed in secondary stream channels in the Dallas area and therefore we can expect to find Paleo-Indian sites in this location as well. Likewise, it is probable that kill sites and short-term camps may be found buried in the recent fill of the river channel adjacent to the river.

The Archaic prehistory of the area is likewise poorly known although we can be certain that the area was occupied continuously after the Paleo-Indian period. A particularly intense Late Archaic occupation is suggested by the numbers of small sites found throughout the surrounding area.

The Archaic peoples participated in a hunting/gathering economy that required seasonal movement in order to gather the available plant and animal resources. We expect that the seasonal movement was centered at a base camp which was occupied on a regular basis each year and that the people moved away from the base camp to hunt, collect vegetable foods, gather nuts and berries, fish, and quarry stone for tools. These latter sites would have been occupied for a specific purpose and for short periods of time. We expect that the base camps are located on the first terrace and that many of the temporary camps are likely to be found on the river floodplain at point bar levees adjacent to the river and minor tributaries and on low knolls or terrace remnants within the floodplain. Quarry sites may be located in the floodplain as well as in the upland second terrace or higher. Sites situated in the floodplain can be expected to be small in area and of shallow depth. Each represents an important part of the seasonal movement of the Archaic hunting/gathering peoples.

The Neo-American period is a direct outgrowth of the Archaic period and three important technological changes occur during this period. There are the introduction and adoption of the bow and arrow, pottery and agriculture. Although hunting and gathering remained an important part of the subsistence base, agriculture may have minimized the need for extensive seasonal movement. This would be reflected in a decrease in the size of short-term sites and possibly in the mumber of these sites. However, it may have forced base camps, or villages, to be moved to spots where agriculturally productive soils and more regular flood water conditions were available in order to maximize agricultural effort. We also expect that the bow and arrow hunting is more efficient in the sense that the use of blind hunting is lessened and stalk hunting becomes easier.

The cultural relationships between people living in the middle Trinity River area are unknown although we expect that a trade relationship existed between the hunting/gathering Trinity people and the highly developed agricultural Caddoan peoples in east Texas. We know nothing about relationships with people to the north, west or south, but there no doubt were contacts which need to be traced.

During the Historic period, the Bidai and Deadose tribes were living in parts of the area until they were removed or exterminated before the mid-1800's. Cultural and linguistic relationship have been described as being between these people and the Caddoans, but archaeology is the only means by which we will be able to explain the types of relationships which occurred. The Wichita lived to the north and are known archaeologically as the Norteño focus (Jelks 1967). The Hasinai Caddo crossed through the area to hunt buffalo. The Vinson site located in Limestone County is the only known evidence of the Tonkawa tribe which may have occupied part of the area. The Akokisa on the south are described historically but are unknown archaeologically except for excavation at Presidio San Agustín de Ahumada near Wallisville Reservoir. Archaeological investigation is the only way that many historic Indian sites located along the Trinity will be found and recorded.

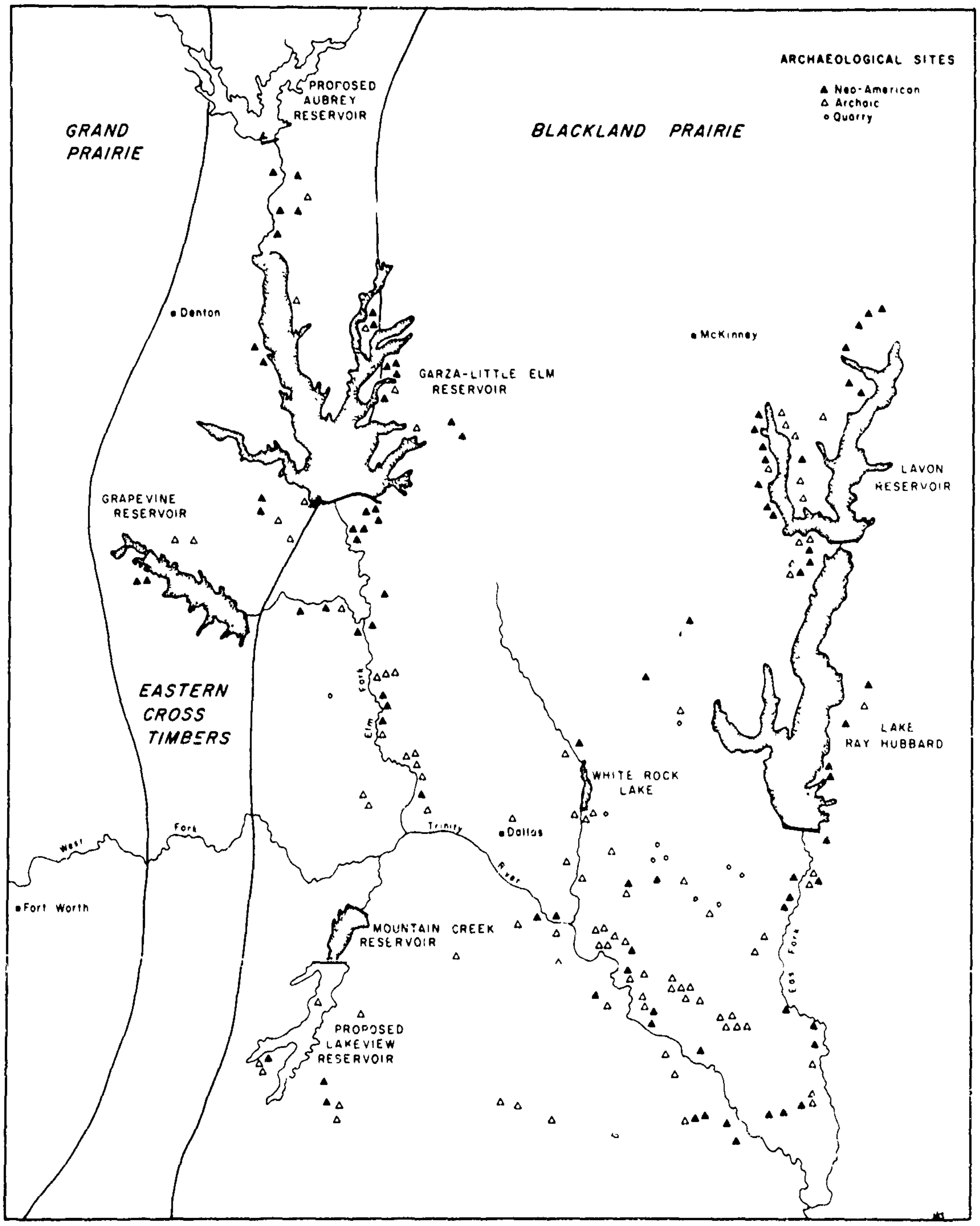

Figure 12. Location of recorded sites in the Upper Trinity Basin.

Upper Trinity River

Archaeological research in the Upper Trinity River basin has been dominated by members of the Dallas Archeological Society. Salvage excavations have been conducted at Lake Lavon, Garza-Little Elm Reservoir and Forney Reservoir but not at White Rock Lake, Grapevine Reservoir, Eagle Mountain Lake, Mountain Creek Lake or Eagle Mountain Lake.

Open village and camp sites are common throughout the area, occurring particularly along the major and minor drainages. These sites range in size from small single occupation hunting camps to deep stratified camp sites which were occupied intermittently for a number of years. Very few of these sites have been adequately excavated and the majority of studies are simply artifact descriptions.

The majority of recorded sites occur at the edge of the Trinity River floodplain or on low rises located within the river floodplain. Many unreported sites may occur under the river silt where they have been buried by repeated overbank flooding.

A review of the pertinent literature presented below shows that there is a long sequence of prehistoric occupation and that considerable work has been done in the Upper Trinity in the area around Dallas. Of particular interest is the Paleo-Indian occupation of the area, the Trinity Aspect (Archaic) occupation and the Neo-American period Wylie Focus which has been described for East Fork.

Three separable physiographic/vegetation zones cut across the Upper Trinity Basin in such a way as to make their definition and general delimitation simple. The basis for the zones is the underlying geological formation which affects the vegetation, soils, water runoff, fauna and the topography. Each zone is described below in order that they can serve as a backdrop for the testing of man's response to their respective resources during the prehistoric period. We expect that the Indians were aware of these differences and knew the various food and other resources that occurred throughout the area. If this is true we can expect that the archaeological remains will reflect this environmental variation. This will be seen in site location and in the different maintenance activities carried out by the prehistoric inhabitants.

The Blackland Prairie is a broad zone which sweeps from northeastern Texas, crosses the Trinity River between Kerens on the east and Grand Prairie on the west and continues southwestward toward San Antonio. Smooth to gently rolling surfaces characterize the upland and the valleys are broad and shallow. Upper Cretaceous limestone/marl formations form the bedrock from which clay soils of the Houston-Wilson and Wilson-Crockett series are derived. Elevation ranges from 400-800' but is nowhere pronounced.

Some small bodies of timber occur on the otherwise "treeless" prairies which are covered by bunch grass. Trees do occur in the alluvial soils along the drainages and these include elm, hackberry, oak, ash, pecan and others. Drainage is rapid due to the clay soils and the many small tributary streams radiating from the major drainages. Rapid runoff results in frequent overbank flooding and deposition of soil on the floodplain.

The Eastern Cross Timbers is a narrow band of oak forest which crosses the Elm Fork of the Trinity in the area of the proposed Aubrey Reservoir and sweeps down Elm Fork through the lower end of Garza-Little Elm Reservoir and then runs west of Elm Fork until it corsses the West Fork of the Trinity River between Grand Prairie and Fort Worth. The Woodbine fm. sand is the bedrock and a fine sandy loam soil, the Kirvin-Norfolk group, is on top of the Woodbine. Elevation ranges from 300-600' and there is no great physiographic relief.

Low, rounded hills typify the area and these are covered with the cover of a thick oak timberland. In some areas the area is savannah like with a broken, patchy woodland. The area is well watered and water penetrates well into the ground rather than running off.

The Grand Prairie adjoins the Eastern Cross Timbers on the east and is in part bounded by the Western Cross Timbers on the west. Lower Cretaceous rocks form the bedrock foundation for the Grand Prairie and the dominant soils are the Denton-San Saba group which are clay and stoney clay. Elevation ranges from 800-1200' and large parts of this range are visible since there are many steep-sided valleys in the otherwise level plain. The plain is smooth to rolling and is deeply dissected by drainages which have narrow bottomlands.

Grass covers (or covered) the prairie but in those areas where shallow stony soils occur, a heavy but small tree and shrub growth occurs. Bison and antelope inhabited the prairie in the historic period. Water is available year-round in free flowing springs and in the major streams. However ground water runoff is rapid due to the nature of the surface cover.

It is proposed that the three areas of the Upper Trinity River Basin were occupied by prehistoric peoples whose economy is linked to the seasonal variation of natural resources and that this is expressed in a central based wandering community pattern. If this is true we would expect:

1) sites located in the river floodplain were occupied on a seasonal basis to collect limited types of specific food resources;
2) floodplain sites will have been repeatedly reoccupied and this will be seen by stratified living floors which have been sealed over by silt deposits;
3) base camps will be located at the edge of the river floodplain but above the regular overflow level of the river;
4) hunting camps and quarry camps will be found in the upland in locations where the respective resources were available.

It is proposed that this model has widespread applicability to the entire area but that specific intra-area responses to the environment will be reflected by:

1) use of area-restricted raw materials, particularly stone and clay;
2) variation in the seasonal foods used due to the nature of the specific zones, for example, more nuts may have been used in the Eastern Cross Timbers, more buffalo may have been eaten by Grand Prairie people since the buffalo was more readily available there;
3) distinct architectural features such as the large pits which occur in Wylie Focus sites along East Fork;
4) differences in intra-site settlement patterns as they reflect the seasonal maintenance cycle and/or the composition of the task groups at each site.

Literature Abstracts

GENERAL

Smith, C. A., Jr.
1969 Archeology of the Upper Trinity Watershed. The Record 26:1:1-14.

This article represents the most recent synthesis of the archaeology of the Upper Trinity Watershed. Smith uses the specific site excavation data and site distribution studies to reconstruct the culture history of the area and to explain the variation in the prehistoric occupation of the natural terrain.

Evidence of early man has been found throughout the Upper Trinity in association with the Pleistocene terrace known as the Upper Shuler. This is the second terrace of the river and in situ archaeological remains have been recorded at Lewisville, near White Rock Creek and Hickory Creek near Denton. Radiocarbon dates are available only from the Lewisville site and these do not agree with dates from early man sites elsewhere in the country. Association of Paleo sites with the second terrace suggests that contemporaneous use of the first terrace and floodplain may have occurred and has since been silted over.

Archaic occupation is known best from Elm Fork and has been described as the Trinity Aspect. This Aspect spans the period and is subdivided into the Carrollton (early) and Elam Focus (later). In contrast to the big game hunters of the Paleo-Indian period, the Archaic people have a diversified economy based on hunting and gathering of seasonally available food resources. Archaic sites are found in place within the first terrace of the river. The nature of floodplain and upland use is as yet unknown.

Large sedentary villages, the use of bow and arrow and pottery, and agriculture are the features which mark the Neo-American period. Two cultural manifestations, the Wylie Focus and the Henrietta Focus, have been reported but understanding of the period throughout the area and the relationship of the peoples is as yet unexplored. An intrusive site is known from Mountain Creek in Dallas County. The site is reported to be a pure Alto Focus site representative of the early Gibson Aspect of the Neches River in East Texas.

Henrietta Focus sites occur along Elm Fork but they are known primarily only through artifact typology. A few burials have been reported but there is no data on houses. The supposedly diagnostic feature of the Henrietta Focus is the presence of a pottery type known as Nocona Plain. No site from this period has been adequately excavated along the Elm Fork of the Trinity. Henrietta Focus is dated to the prehistoric period.

The Wylie Focus is a manifestation that has been recorded on the East Fork of the Trinity. Its geographic boundaries are unknown. Large circular subterranean pits are diagnostic of the focus and are dated to the early Neo-American period on the basis of trade pottery from East Texas. Large villages occur in the river floodplain but very little is known of the villages except for burials and the large pits. Moreover the small seasonal sites are unreported and this results in a biased understanding of the way-of-life of the Wylie Focus peoples.

Evidence of historic Indian occupation of the area is unknown although documentary evidence suggests that the historic Wichita traveled and lived in the area.

In summary, Smith points out that the Upper Trinity has been occupied from the Paleo-Indian period through the early Historic period. Little is known about the Paleo-Indian and Archaic occupation and this needs to be better studied. Additional study of the Neo-American sites will be required in order to determine the importance of pottery making and the way-of-life of the prehistoric peoples.

EAST FORK OF THE TRINITY

Forney Reservoir

Harris, R. K.
1936 Indian Campsites in the Upper Trinity Basin. Bulletin of the Texas Archeology and Paleontological Society Vol. 8.

Wilson, Lester
1946 Problematical Pits on East Fork. The Record 5:2:11-12.

Harris, R. K. and Dee Ann Suhm (eds.)
1963 An Appraisal of the Archeological Resources of Forney Reservoir, Collin, Dallas, Kaufman and Rockwall Counties, Texas. Report submitted to the National Park Service by the Texas Archeological Salvage Project.

Thirty three prehistoric sites were recorded within the area of Forney Reservoir; these include sites with an unidentified Archaic complex occupation and with occupation during the Neo-American Wylie Focus. Dating of the latter sites is done through the presence of trade pottery from the Caddoan area of East Texas.

Wilson, Lester
1941 Campsite on East Fork near Wylie. The Record 2:5:23-25.

Housewright, Rex and Lester Wilson
1942 A Flaking Tool Burial at Butler Hole, Collin County, Texas. The Record 3:7:40-44.

Housewright, Rex, Lester Wilson and R. K. Harris
1947 The Butler Hole House Site. The Record 6:3:8-16.

The Butler Hole site is a Wylie Focus village (house site) which was reported by members of the Dallas Archeological Society. The site is located in the river bottom. Burials and houses have been reported from the site. The house was circular with postholes around the perimeter and the wooden framework was covered with clay daub. Adult burials associated with pottery, stone tools, bone, broken gorgets and flaking tools have been uncovered.

Wilson, L.
1952 A Preliminary Report on the Glen Hill Site 27Bl-6. The Record 11:1:2-4.

Ross, Richard E.
1966 The Upper Rockwall and Glen Hill Sites, Forney Reservoir, Texas. Papers of the Texas Archeological Salvage Project, No. 9.

Preliminary work at the site was done by Wilson and limited salvage work by Ross for the Texas Archeological Salvage Project. Six human burials and three shell concentrations were recorded but excavation was terminated due to a disagreement with the landowner.

Lavon Reservoir

Dallas Archeological Society
1965 Excavation of the Branch Site. The Record 21:1:4-18.

The Branch site is located at Lavon Reservoir and was tested by amateur archaeologists from Dallas. There is an Archaic occupation but the majority of excavation was confined to the Wylie Focus (Neo-American) occupation of the site.

Stephenson, Robert L.
1949 Archeological Survey of Lavon and Garza-Little Elm Reservoirs: A Preliminary Report. Bulletin of the Texas Archeological and Paleontological Society 20:21-62.

1949 A Note on Some Large Pits in Certain Sites Near Dallas, Texas. American Antiquity 15:1:53-55.

1952 The Hogge Bridge Site and the Wylie Focus. American Antiquity 17:4:299-312.

River Basin Salvage survey of the proposed Lavon Reservoir recorded 13 Archaic sites (or componants) and 12 pottery (Neo-American) sites. At the time it was noted that all villages (six larger sites) were located within the river floodplain but that there also were 19 small temporary camp sites. Excavation was conducted at the Campbell Hole site and the Hogge Bridge site since each of these was a large Wylie Focus village. A large pit of unknown function was partially excavated at Hogge Bridge and 13 human burials were collected. It was suggested that the Wylie Focus people were somehow related to the Caddoan people of East Texas and to the Southern Plains.

Harris, R. K.
1945 Bone Implement Burial, Collin County, Texas. Bulletin of the Texas Archeological and Paleontological Society 16:84-89.

1947 An Infant Burial. The Record 6:4:18-19.

1948 A Pottery Site near Farmersville. The Record 6:10:38-45.

1960 Burial 1, Site 27B1-2 Rockwall County and Burial 5, Site 18D4-1, Collin County. The Record 15:2:8-10.

Attention was paid to the Dugger site before Lake Lavon was built and the site's importance is still poorly understood because little is known other than several burials.

Hanna, Henry, Jr.
1940 A Burial in Collin County. The Record 1:9:37-38.

A late prehistoric burial from the Westminster site is described.

Lorrain, Dessamae
1968 A Survey of the Archeological Resources of Soil Conservation Site 41 Reservoir, East Prong of Whites Creek, Grayson County, Texas. Report submitted to the National Park Service by the River Basins Salvage Project at Southern Methodist University.

The archaeological survey of a small Soil Conservation Service reservoir at the upper end of the East Fork drainage is described.

Additional East Fork Bibliography

Hanna, Henry, Jr.
1941 Two Rockwall County Indian Campsites. The Record 3:3:14-17.

Housewright, Rex, Lester Wilson and R. K. Harris
1948 Culture Traits, Wilson Hole Site. The Record 6:6:25-28.

Blair, Bill
1960 A Burial at Lower Rockwall. The Record 15:1:5-6.

Harris, R. K.
1948 Traits Lists of Our Area-Rockwall 2(392/RW2). The Record 6:5:20-23.

1960 Burial 1, Site 27B1-2 Rockwall County and Burial 5, Site 18D4-1, Collin County. The Record 15:2:8-10.

The Lower Rockwall site is a kitchen midden site situated on a low hill overlooking East Fork. Several burials have been reported from the site by amateur archaeologists.

Hanna, Henry, Jr.
1941 Two Rockwall County Indian Campsites. The Record 3:3:14-17.

Hanna, Henry J. and R. K. Harris
1948 Burial 5, Site 27B1-1. The Record 7:3:10-11.

Harris, R. K.
1948 Culture Traits, Rockwall 1 (392/RW1). The Record 6:9:35-37.

1948 Two Cremated Burials: Site 27B1-1 (RW1). The Record 7:2:7-9.

1949 Excavation of Fire Pite, Site 27B1-1. The Record 8:2:-6-8.

Harris, R. K., John Perkins and J. B. Sollberger
1957 Burials 6,7,8 and 9. Site 27B1-1. The Record 14:3:12-15.

Sollberger, J. B. and R. K. Harris
1949 Burials 6 and 7, Site 27Bl-1. The Record 7:8:27-28.

Ross, Richard E.
1966 The Upper Rockwall and Glen Hill Sites, Forney Reservoir, Texas. Papers of the Texas Archeological Salvage Project. No. 9.

The Upper Rockwall site has been known for many years and several burials have been recorded. Houses similar to the Butler Hole site are also present. A large Wylie Focus pit at the site was tested by the Texas Archeological Salvage Project but their findings were unconclusive.

Hatzenbuehler, Robert
1942 The Ragland Site. The Record 4:1:3-13.

1948 Culture Traits, Ragland Site. The Record 6:8:32-33.

The Ragland site is located on the west branch of the East Fork of the Trinity and is situated on a low rise 20 feet above the river bottom. The site is a midden 20 to 100 feet wide and 600 feet in length. Evidence for Archaic and Wylie Focus occupation of the site is present.

Harris, R. K.
1942 The Gilkey Hill Pottery Site. The Record 3:9:48-53.

1948 Preliminary Report on an Alto Focus Site in Kaufman County. The Record 7:4:13-15.

Hatzenbuehler, Robert
1947 A Net Sinker Site near Trinidad, Texas. The Record 6:1:1-4.

TRINITY RIVER AND TRIBUTARIES

Hatzenbuehler, Robert C.
1942 Some Interesting Indian Workshops in Dallas County. The Record. 3:5:28-31.

This brief article concentrates on the description of a number prehistoric workshop sites located in the Mesquite-Seagoville area. A map showing the location of workshop sites and of camp or village sites is included. (Workshop sites are spots where chippable stone, usually in the form of cobbles, was gathered or quarried by the Indians.) There are 12 prehistoric campsites shown as located along the Trinity between the mouth of Prairie Creek and White Rock Creek. Although this does not include all the sites in the area it does suggest that workshop sites occur on the upland away from the river and along the drainage creeks.

Kirkland, Forrest
1942 A Series of NonPottery Sites in Dallas County, Texas. The Record 3:6:32-38

In this article Kirkland describes the then known archaeological resources on both sides of the Trinity from a mile southeast of Seagoville to 2 miles northwest of Kleberg. The locations of non-pottery and pottery are shown on a sketch map. Pottery sites (Neo-American) are found to be located on sandy soil which is found west of the river on the leading edge of the river terrace (6 sites) or in the river bottom (4 sites). Non-pottery sites (Archaic) occur on the yellow clay hills at the edge of the terrace and both sides of the river (19 sites are shown).

Hanna, Henry, Jr.
1940 A Most Interesting Dallas County Indian Campsite. The Record 2:2:8-11.

This site is located on Honey Creek south of the Trinity. The creek is fed by a small spring and in this area a grooved stone axe, six whole pottery vessels and three pottery effigy heads (figurines) were recovered. The site probably represents late Neo-American occupation.

Crook, Wilson W., Jr. and R. K. Harris
1955 Scottsbluff Points in the Obshner Site near Dallas, Texas. Bulletin of the Texas Archeological Society 26:75-100.

Shiner, Joel L.
1970 Activity Analysis of a Prehistoric Site. Bulletin of the Texas Archeological Society 41:25-35.

The Obshner site is an early Archaic site located on the first terrace east of the Trinity near Kleberg. The archaeological deposit is thin and excavation revealed that this represents a campsite repeatedly visited by hunting parties. Occupation is primarily during the early Archaic period, sometime before 4000 B.C.

General Dallas References:

Gwin, Thomas B.
1941 An Interesting Type of Indian Artifact from Dallas and Ellis County. The Record 2:9:41-43.

Harris, R. K.
1936 Indian Campsites in the Upper Trinity Basin. Bulletin of the Texas Archeological Society, Vol. 8 TAS Annual Report.

1941 Additional Information about Dallas County Hand Axes. The Record 3:1:3.

Hatzenbuehler, Robert C.
1948 Disturbed Burial near Seagoville. The Record 6:8:33.

White Rock Creek

Harris, R. K.
1949 Burial 7, Site 27A5-19. The Record 7:7:24-25.

Hatzenbuehler, Robert and R. K. Harris
1949 Burial 5, Site 27A5-19. The Record 7:6:21-22.

Kirkland, Forrest and R. K. Harris
1941 Two Burials Below the White Rock Lake Spillway. The Record 2:10:49-54.

A prehistoric campsite located on the east bank of White Rock Creek was being slowly eroded away by overflow of the creek. Members of the Dallas Archeological Society salvaged a number of burials which were exposed by erosion. The site is probably late Archaic in age based on the projectile point styles and the absence of pottery.

Sollberger, J. B.
1953 The Humphrey Site. The Record 11:3:11-14.

The Humphrey site is a late prehistoric/early historic site located on the west side of White Rock Creek and was destroyed during construction of a housing development adjacent to the White Rock Creek Lake.

Harris, R. K. and Inus Marie Harris
1970 A Bison Kill on Dixon's Branch Site 27A2-5, Dallas County, Texas. The Record 27:1:1-2.

A bison kill site is reported from Dixon's Branch which is a tributary of White Rock Creek. The bison was associated with the gray-black silt geologic deposit and three Fresno arrow points were found in the rib cage. Therefore an inferred date of late prehistoric/early historic can be attributed to the bison kill. The authors note that they know of "many archeological sites located in and on the terraces of small creeks in the Dallas area, such as Ash Creek, Upper White Rock Creek, Duck Creek, Five Mile Creek, Ten Mile Creek, Bear Creek, and others..."

Lagow Discovery

Crook, Wilson W., Jr.
1961 A Revised Interpretation of the Lagow Discovery, Texas. American Antiquity 26:4:545-548.

Oakley, K. P. and W. W. Howells
1961 Age of the Skeleton from the Lagow Sand Pit, Texas. American Antiquity 26:4:543-545.

Shuler, Ellis W.
1932 Figurine From a Gravel Pit of Dallas, Texas. Bulletin of the Texas Archeological and Paleontological Society 4:79-80.

1934 Collecting Fossil Elephants at Dallas, Texas. Bulletin of the Texas Archeological and Paleontological Society 6:75-79.

Paleontological work in the twenties unearthed a human skeleton which was reportedly in association with Pleistocene age fauna. Reevaluation of the geologic context and chemical analyses show that the skeleton is not as old as the associated fauna. With the aid of recent radiocarbon dates Crook attributes the skeleton to the Early Archaic (greater than 9500 B.P.) and prior to the red clay veneer on the first terrace of the Trinity.

ELM FORK OF THE TRINITY

Crook, Wilson, W., Jr. and R. K. Harris
1952 Trinity Aspect of the Archaic Horizon: The Carrollton and Elam Foci. Bulletin of the Texas Archeological and Paleontological Socity 23:7-38.

The Carrollton and Elam foci make up an Archaic manifestation which occurs throughout parts of the Blackland Prairie and may extend into the Eastern Cross Timbers. Sites assigned to this period are typically found on the first terrace of the Trinity at a spot where a small tributary cuts through the terrace to reach the floodplain. Trinity Aspect sites are generally in a buried condition and often later Neo-American sites overlie the Archaic site. Neo-American sites are also found in the river floodplain.

Kirkland, Forrest, R. K. Harris and Robert Hatzenbuehler
1949 Refuse Pits Excavated in Site 27A-1-2. The Record 7:5:17-19.

Hughes, Jack T. and R. K. Harris
1951 Refuse or Fire Pit Excavated in Site 27A1-2. The Record 10:2:7-8.

A non-pottery site is located on the west side of Elm Fork near the Carrollton dam.

Crook, Wilson W., Jr. and R. K. Harris
1953 Some Recent Finds at the Wheeler Site near Carrollton. The Record 11:5:21.

1954 Traits of the Trinity Aspect Archaic: Carrollton and Elam Foci. The Record 12:1:2-16.

1954 Another Distinctive Artifact: The Carrollton Axe. The Record 13:2:10-18.

1959 C-14 Date for Late Carrollton Focus Archaic Level: 6000 Years B.P. Oklahoma Anthropological Society Newsletter 8:3:1-2.

A summary of the archaeology and more recent work is provided by these articles. Of particular importance are radio-

carbon dates which show that the Elam focus represents the period 6000-4000 B.P. and that Carrollton focus is older.

Lorrain, Dessamae
1963 A Cache of Blades from Carrollton, Texas. The Record 18:1:2-7.

1966 A Site in Northwestern Dallas County. The Record 23:1:2-4.

A brief description of a Carrollton Focus site located on the first terrace of Elm Fork and known as the County Line site.

Eastern Cross Timbers

ELM FORK OF THE TRINITY

Harris, R. K.

1936 Indian Campsites in the Upper Trinity Basin. Bulletin of the Texas Archeology and Paleontological Society Vol. 8.

1939 A Survey of Three Denton County Indian Village Sites. The Record 1:2:6-8.

1940 Two Indian Village Sites near the City of Denton. The Record 2:1:5-6.

These articles point up the interest of local amateurs in the archaeology of the Upper Trinity. Six sites are reported in the articles. All of the sites are in the general Lake Dallas area and are on both sides of Elm Fork. Included is evidence of Paleo-Indian occupation (Folsom), early Archaic (Waco sinkers and dart points), late Archaic (dart points) and Neo-American (pottery) occupations. All of the sites are within a quarter mile of the river and several cover 3-4 acres of land.

Harris, R. K.

1949 The Jordan Farm Site. The Record 8:1:2-4.

The Jordan Farm site is located just south of Gainesville at the upper end of Elm Fork. Two hearths and a human burial were recovered in the river bank and were salvaged.

Harris, R. K.

1950 Preliminary Report on Site 18C7-10. The Record 8:5:21-22.

18C7-10 is located on the west side of Elm Fork and is situated on a sandy rise. It is a Neo-American site with pottery and obsidian. The latter probably represents trade from New Mexico. Evidence of houses is inferred from stone circles.

Harris, R. K.

1951 A Preliminary Report on Site 18C4-6 in Denton County, Texas. The Record 9:4:18-19.

This is a multicomponent site situated on Little Elm Creek and subsequently flooded by the enlarged Lake Dallas. Eroded materials were collected but salvage excavations were not possible.

Harris, R. K.
1951 Plainview Point from Site 18C7-3. The Record 10:1:2.

Stephenson, Robert L.
1949 Archeological Survey of Lavon and Garza-Little Elm Reservoirs: A Preliminary Report. Bulletin of the Texas Archeological and Paleontological Society 20:21-62.

Crook, Wilson W., Jr. and R. K. Harris
1957 Hearths and Artifacts of Early Man near Lewisville, Texas and Associated Faunal Material. Bulletin of the Texas Archeological Society 28:7-97.

1958 A Pleistocene Campsite near Lewisville, Texas. American Antiquity 23:3:233-246.

The Lewisville site was exposed when twenty feet of overburden were removed in a borrow pit excavation at Garza-Little Elm Reservoir. Erosion continued the soil removal and exposed a Pleistocene living floor in which 21 hearths were located. Associated with the living floor was a Clovis point, a chopper, hammerstone, flake scraper and three flakes. Two charcoal samples yielded date of greater than 37,000 B.P. It is this fact that makes the site, which is now under water, particularly significant. Clovis occupation is generally attributed dates of about 10,000 B.C. rather than 37,000 B.P.

Crook, Wilson W., Jr. and R. K. Harris
1962 Significance of a New Radiocarbon Date from the Lewisville Site. Bulletin of the Texas Archeological Society 32:327-330.

Analysis of additional charcoal samples yielded a date of greater than 38,000 B.P. thus tending to confirm the previous dates. Many archaeologists are willing to accept the date but tend to reject the association of the artifacts with the "hearths."

Harris, R. K.
1959 C-14 Date on Henrietta Focus in Texas. Oklahoma Anthropological Society Newsletter 8:3:2.

A radiocarbon date of 375 ± 145 B.P. (A.D. is derived from a Henrietta Focus site located on Elm Fork. Artifacts include shell tempered pottery and small triangular (Fresno) arrow points.

Barber, Byron L.
1966 The Irish Farm Site, 18C4-2. The Record 22:2:9-14.

The Irish Farm site is located 50 yards east of Little Elm Creek and has been exposed by erosion caused by Garza-Little Elm Reservoir. There is evidence of occupation during the Carrollton Focus and the Henrietta Focus but little is known about the site except the artifacts.

Denton Creek

Benham, Blake L.
1969 X41MU15, A Site on the Headwaters of Denton Creek, Montague County, Texas. Bulletin of the Texas Archeological Society 40:209-214.

Gibson, Jon L.
1969 Sites and Environment: A Study of the Archaeology of a Portion of the Denton Creek Watershed, Wise County, Texas. Bulletin of the Texas Archaeological Society 40:199-209.

Archaeological sites at the upper end of Denton Creek tend to be small in area and seem to represent short-term occupations. Comparison between sites in this area and the major drainages points up the differences and emphasizes the importance of the virtually unknown small sites.

Morris, Virginia and Bill Morris
1970 Excavation of Bison Remains in Northwest Dallas County. The Record 27:1:2-5.

The scattered remains of a bison were recovered adjacent to the edge of Denton Creek. A Fresno point found in the area dates the site to the late prehistoric/early historic period. The site is interpreted as a buffalo kill and butchering site regardless of the absence of chipped stone tools.

Stephenson, Robert L.
1949 Archeological Survey of Lavon and Garza-Little Elm Reservoirs: A Preliminary Report. Bulletin of the Texas Archeological and Paleontological Society 20:21-62.

This report mentions that few important archaeological sites were recorded at Grapevine Reservoir.

Summary

The known archaeology of the Trinity River Basin is biased in two respects. First, most of the excavation has been of a salvage nature aimed purely at developing a local chronology and fitting the chronology into a state-wide time framework. Secondly, most of the reported sites are from the later time periods (Late Archaic, Neo-American). This is because these sites are closest to the present ground surface and thus easily exposed by farming and erosion. Of all the work discussed in the preceding sections, only the work of members of the Dallas Archeological Society at the Wheeler, Lewisville, Obshner and several other sites, has been concerned with early occupation in the Dallas area. Consequently this early time period is of particular importance should sites of this period be present in the channel area. On the basis of work on the Brazos River (Blaine, Harris, Crook and Shiner 1969; Skinner and Rash 1969; Story and Shafer 1965) we have reason to believe that early occupation did occur and can be expected to be buried in the river terraces and floodplain. Consequently particular concern should be given to investigating the early remains and in developing a firm chronology that can be used to tie sites down in time.

Once a site has been related to a specific period of time then it also will have to be evaluated with regard to its place in the yearly movement of its prehistoric or historic occupants. As stated earlier, the presently available data are inadequately for an evaluation of the occupation in any part of the Trinity. Information about the different types of sites, their locations, the associated tools and food remains must be collected in order to evaluate the relative importance of any specific site that will be directly affected by construction.

It is the suggestion of this author that a reconnaissance inventory of the archaeological resources be conducted in order to sample the obserable remains that are present. Such a survey would involve carrying out evaluations of the resources in broad transects (possibly a mile wide) which would be spaced at 20 mile intervals along the river and specifically at the location of proposed locks and dams. This information would be used to determine the nature of site preservation and exposure, location and situation of different site types, artifactual remains both on the ground and in the hands of local collectors, the density of sites and the periods of occupation present in each area. With the insights provided by these data, the research designs can be refined and used to carry out in-depth evaluation of the resources within the entire area.

An in-depth archaeological site survey will be necessary to determine the importance of the archaeological resources and the impact that construction will have. The reconnaissance transects can be used as controls with which the remains found in the intervening area can be compared. Moreover the small intervening areas will insure a systematic coverage of the river area. This survey should be done by an interdisciplinary team which includes a paleontologist and a botanist. Detailed information on 1) site situation with reference to present topography and river channels; 2) site size and depth (where determinable by erosion or testing); 3) the types and amounts of food remains; 4) the period or periods when a site was occupied; 5) the types of artifacts (tools, pottery, stone, etc.) present and their specific locations on the site's surface; and 6) the specific activities carried out at the site and consequently the site type. These data will be needed to evaluate the importance of archaeological sites.

Upon completion of the survey and analysis the archaeologist will be able to propose a model which explains the intersite variation in terms of changes through time and space. On the basis of this model, he will be able to determine the requirements for archaeological salvage of an adequate sample of the recorded sites if the decision is made to conduct the channelization as planned.

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CHAPTER IV

HISTORICAL RESOURCES IN THE UPPER TRINITY RIVER BASIN

by

Robert D. Hyatt
Research Archaeologist
Department of Anthropology

HISTORICAL RESOURCES IN THE UPPER TRINITY RIVER BASIN

Reported herein are the results of a literature survey of historical and ethnohistorical resources in the Upper Trinity basin north of Tennessee Colony, Texas. The purpose of the study is to provide data relevant to the preparation of a statement of environmental impact of proposed canalization and reservoir construction on these resources. The study area comprises the Trinity River Basin in Ellis, Kaufman, Dallas, Tarrant, Rockwall, and Denton Counties, Texas.

Historical and ethnohistorical sources were examined for references to both general settlement history of the area, and specific mention of location of known sites. R. King Harris of Dallas was particularly helpfull in suggesting possible source materials because of his intimate knowledge of the history and prehistory of the area. Sources examined include general Texas histories, County histories, reminiscences, and economic and urban growth studies relevant to the area.

Due to the relatively late settlement of the area and its remoteness from Spanish settlement activities such as occurred on the Lower Trinity River, very few historical resources such as frontier forts or early missions were erected. Consequently, the historic resources consist primarily of whatever may remain of early settlements, many of which have already been obliterated by later urban development. The available County histories and publications concerned with Upper Trinity River transportation facilities provide some scattered information concerning specific historical locations, but no good over-all sources are available. The ethnohistory of the Indian groups residing in the area in historic times is practically unknown.

The specific historical and ethnohistorical sites noted in this report do not represent all such sites known to have been located within the study area, but only those which are sufficiently documented as to probable location. Many such sites have already been obliterated by commercial and domestic activities, and intensive survey will be required in order to locate and identify those still remaining.

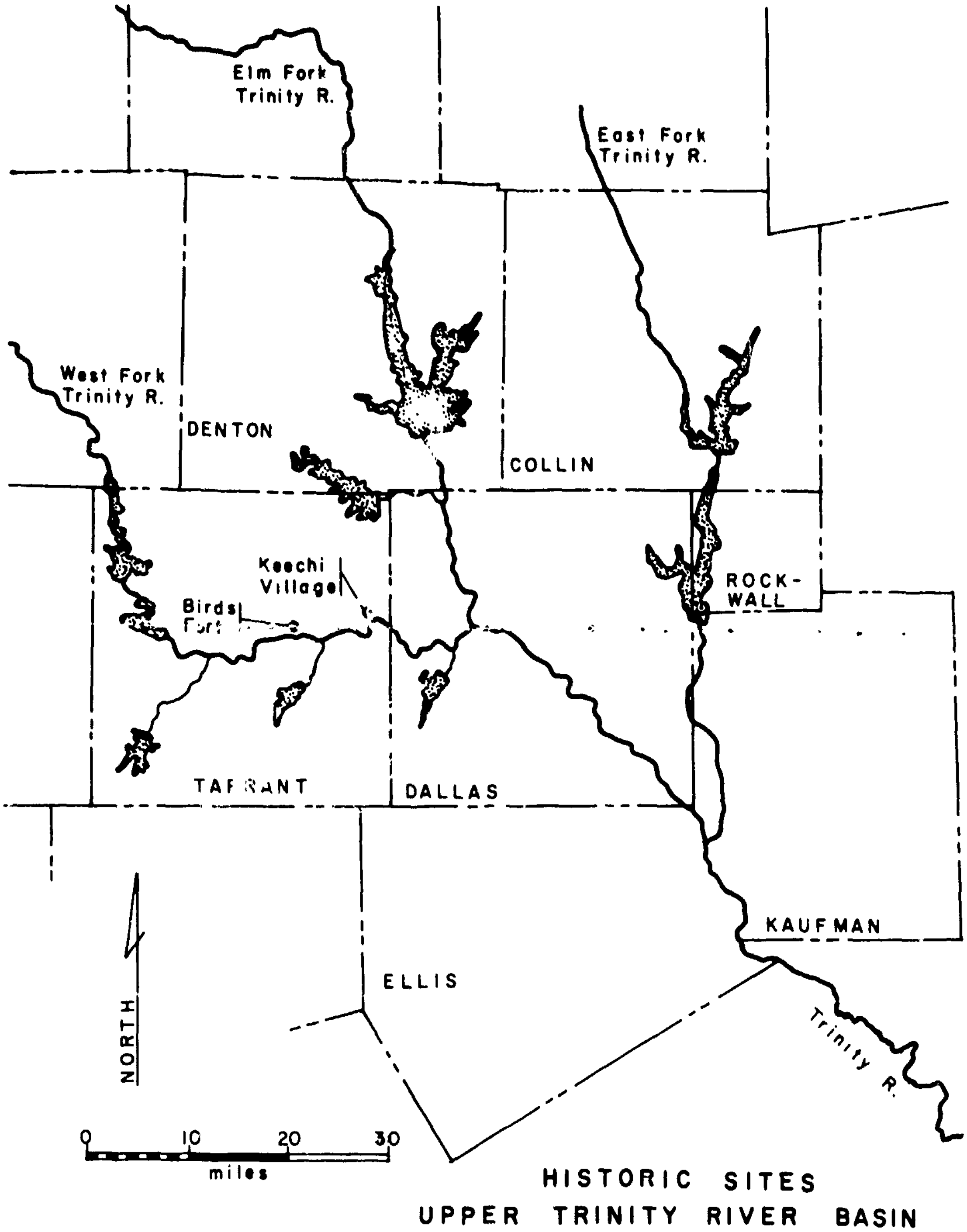

Figure 13. Historical sites in the Upper Trinity Basin

Historical Summary

Recorded history on the Upper Trinity River begins considerably later than that for the Lower Trinity River or Red River areas. Actual settlement of the area did not begin until the early 1840's, whereas the Spanish were on the Lower Trinity in the late 17th Century (Bolton 1913), and the French had settlements on Red River as early as 1716 (Yoakum 1935: 81). Spanish expeditions under Alonzo De Leon, Teran, and Captain Don Ramon had penetrated to the Red River area in the 17th Century (Bolton 1925: 349; Garrison 1903: 31), but did not pass through the Upper Trinity area. This is also the case for late 18th Century Spanish Expeditions (Bolton 1914: map, frontpiece). Foreign settlement in the early 1800's did not extend as far north as the Upper Trinity Basin (Hatcher 1927).

Colonization of the Upper Trinity area did not begin until the 1840's. This was still a very remote area of the frontier, and the impetus for early colonization was the navigation of the River by a few small iron steamers. The first navigation of the River as far north as Dallas was made by the Scioto Belle in 1836. However, settlement of the area was initially slow because of the necessity of utilizing wagon transportation for shipment of merchandise into, and local products out of the area. It was not until 1852 that an attempt was made to utilize the Upper Trinity Triver for commercial transportation (Brown 1930: 35). Between 1852 and 1874 it was estimated that nearly 50 boats were continuously navigating the Trinity as far north as Trinidad in Kaufman County and Porter's Bluff in Ellis County (White 1965: 23).

To facilitate commercial navigation of the River, a number of locks and dams were constructed. Nine of these were completed beginning in 1909, including one nine miles below Dallas, one at McCommas Bluff, fifteen miles below Dallas, one at Parsons' Slough twenty-six miles below Dallas. A total of seven were constructed between Dallas and fifty miles south, and two more halfway between Dallas and Galveston (Brown 1930: 50).

The advent of railway transportation in 1872 was also instrumental in the development of the area. With the arrival of the H. and T. C. Railroad in 1872 and the Texas and Pacific Railroad in 1873, the population of Dallas rose from a few hundred to nearly 4,000. These were important events in the urban development of the area as the new transportation facilities were necessary for shipments of cattle and wheat from Fort Worth, and Cotton from the Dallas area.

Because of the remoteness and late date of settlement of the Upper Trinity area, forts were not constructed for protection of this frontier until relatively late. Bird's Fort was in operation by 1840, and Fort Worth was the northernmost of a series of forts stretching from the Rio Grande to the Upper Trinity River (Conger, et al 1966: x-xii). Camp Worth was established by Major Ripley A. Arnold at the juncture of the West Fork and Clear Fork of the Trinity River in 1849. In June of that year the name was changed to Fort Worth, although no actual fort was ever constructed. In 1854, troops from Fort Worth were removed to Fort Belknap to the west (Brown 1930: 59-60). Fort Richardson was located to the northwest of Fort Worth in Jack County (Toulouse 1936; 55), and Fort Graham was 80 miles to the south in Hill County.

Ethnohistorical Data

Ethnohistorical data for the area is relatively scarce and poorly documented. The major Caddoan Confederacy settlements were located to the south on the Lower Trinity and Neches Rivers (Bolton 1915: 3-4; Heusinger 1936: 196; Newcomb 1961: 250) and to the east and north on Red River. The Upper Trinity area was occupied primarily by Kichai groups of Caddoan stock (Swanton 1953: 321). Reference is also made to Yojuane tribes living in the upper reaches of the Trinity (Bolton 1915: 165). The Kichai groups were probably located to the north of Red River prehistorically, but inhabited the area south of Red River into the Upper Trinity drainage from before 1700 until the 1850's when they were moved to a reservation on the Brazos River. Keechi Creek, a branch of the Trinity River, and a post hamlet in Leon County derive their names from this source (Swanton 1953: 321-322). Specific reference is made to a Keechi Village being occupied in 1841 (Bates 1918: 8). This site was said to have been located at the junction of Village Creek and the West Fork of the Trinity River, six miles east of Fort Worth. It is probable that many such sites existed in the Upper Trinity Basin just prior to colonization of the area, but were abandoned as the area became settled. In spite of the scarcity of ethnographic or historical references to specific site locations, careful survey should locate many of these and thus add to our knowledge of the protohistoric utilization of the area.

Historical Data

Bird's Fort on the Trinity River about twenty-five miles south of present Denton has been fairly well documented (Bates 1918: 158; Swanton 1942: 97; Newcomb 1961: 348; also map in Newcomb 1961: 161). This was a log structure on the eastern edge of present Tarrant County, where in September of 1843 the Republic of Texas concluded a treaty of peace with several Indian tribes, including Caddoes, Delawares, Shawnees, and Wichita subtribes. The fort was later named Birdsville and became the first county seat of Tarrant County.

Central National Road of the Republic of Texas (also known as the Preston Road): Authorized by the Eighth Congress of Texas in 1844 to serve as a means of promoting emigration from the north. It began on the bank of the Trinity River near the Dallas County Courthouse and ran north up Collin County Ridge to Preston's Bend on Red River, seventy miles to the north (Bates 1918: 4).

Ferry Crossings (Cochran 1928: 119-121):

Dawdy's Ferry - located near Hutchins, south of Dallas.

Miller's Ferry - upriver from Dawdy's Ferry; gave access to Dallas for the Hutchins Community.

At Dallas there was a ferry crossing at the foot of Commerce Street.

The next crossing up the river was at the mouth of Turtle Creek. This was not extensively used and was soon abandoned.

Cedar Springs Crossing - the next crossing upriver, on the road leading from Cedar Springs to the Eagle Ford neighborhood.

Record Crossing - provided access to Dallas from the Stults or Sowers neighborhood in the forks of the river.

Minter Crossing - upriver from Record Crossing.

California Crossing - the best crossing on Elm Fork for passage from Dallas to the north.

Keenan's Ferry - located on Elm Fork west of present Farmers Branch; built in 1850 to provide a good access to Dallas for the Grapevine community.

Trinity Mills Crossing - established in 1850 west of Trinity Mills, giving access to Dallas for the Parish neighborhood.

All of the Crossings on Elm Fork were destroyed or replaced by bridges when dams were built across the river for the purpose of impounding water for domestic use (Cochran 1928: 121).

Mills (Cochran 1928: 116-117):

Grist Mill (1858) - at Record Crossing on Elm Fork of the Trinity River.

Water Mill - at Eagle Ford on the West Fork of the Trinity River, about ten miles west of Dallas.

Todd Mills - located at the intersection of the Texas and Pacific Railway and the Trinity River.

Summary and Recommendations

After the initial settlement of the Upper Trinity Basin beginning about 1840, river navigation and rail transport provided the incentive for rapid population of the area after 1872. Few forts were built for the protection of the early settlers, and those that were in operation were short-lived. This area was an unknown wilderness during the Spanish missionizing and colonizing period, and no missions were established this far up the Trinity River. The historical resources of the area consist primarily of the remains of early settlements dating after 1840, most of which have been obliterated by urban growth.

The ethnohistorical data for the area is very scarce and imprecise. Sites of protohistoric occupation may be expected to exist in some numbers in the area, but great difficulty will be encountered in attempting to correlate these with specific references in the historical literature.

The results of the literature survey for the Upper Trinity Basin suggest that the published sources may be of only limited value in locating and assessing the historical resources present in the area. Ground surveys of the areas to be disturbed or destroyed will be necessary for proper evaluation of what is actually present and of value in historic terms.

One other avenue of research not attempted in this study may prove of value in conjunction with ground survey. The probability exists that a thorough search of early newspapers for the area may provide bits of additional information which may be useful in identifying historical sites located by survey. It is suggested that local historical societies in the various counties involved be contacted with regard to undertaking this phase of the research for each county.

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CHAPTER V

HISTORICAL RESOURCES IN THE

MIDDLE TRINITY RIVER BASIN

AD 1517 - 1860

by

Michael L. Scott
Assistant Archaeologist
Department of Anthropology

HISTORICAL RESOURCES IN THE MIDDLE TRINITY BASIN AD 1519 - 1860

Introduction

A review of historical events within the Middle Trinity Basin was undertaken in an attempt to determine the effect of construction activities, associated with canalization and reservoir construction on these resources. The following is an interim report on the findings which will be expanded for the area and other areas in a final report.

The literature was reviewed in terms of a general overview of events within and without the Trinity Basin. An attempt is made to classify the events into a coherent historical framework, in order to gain an idea of the historical importance of information within the Trinity. Brief summaries of the history are presented; by chronological period. Where possible, the general and specific localities of historic remains are noted, so that provisions can be made for field inspection.

The history has been divided into a number of periods on the basis of general class of events in the middle Trinity, and elsewhere. These are:

AD 1519 - 1715	Primarily exploratory
AD 1715 - AD 1800	Initial settlement activity of a sporadic nature
AD 1800 - 1836	Planned settlement by the Spanish
AD 1836 - 1860	The classic phase of settlement within the Trinity based on river transport.

Exploration Period

A.D. 1519 - A.D. 1715

Spain began to accumulate information concerning Texas in A.D. 1519 when Garay, the Governor of Jamaica, initiated a project to map the Gulf coast from Florida to Tampico (Barker 1929). The survey, under the direction of Alvarez de Pineada, was accomplished from a ship and inland explorations were not carried out.

It was not until 1528 that the first Europeans, survivors of the Narvaez Florida expedition, led by Cabeza de Vaca, set foot in Texas. De Vaca's exploration accounts are vague and exact locations cannot be determined from his memoirs (Bandelier 1905, Hodge 1907).

Although a number of parties penetrated the present area of Texas, there are no records of exploration within the mid-Trinity area from A.D. 1519 until A.D. 1685, with the exception of Luis de Moscosco's journey in A.D. 1543 which may have crossed the Trinity (termed the Daycao River) southwest of Crockett, Texas and north of the present Leon-Madison County line (Swanton 1942: 31-2).

In general, information accumulated between A.D. 1519 and 1685 was indirect and concerned with the location of settled village tribes in the eastern and northeastern part of Texas. The majority of Spanish effort during the period was directed toward exploration and settlement of Mexico and New Mexico. As a result, there was slight impetus for coordinated explorations elsewhere (see Garrison 1903, Bolton 1912).

Subsequent to A.D. 1685, the situation changed because of territorial conflicts between the French and Spanish. By this date, the French had accomplished explorations in Canada and were actively engaged in tracing out the course of the Mississippi River. In 1685, Rene Robert Cavelier, Sieur de la Salle attempted to establish a settlement at the mouth of the Mississippi but sailed too far west. A party under La Salle's leadership consequently established an expedition base camp, Fort St. Louis, at Matagordo Bay in February of 1685. Parties were than sent out to explore the river systems to the northeast. Movements of the expedition were recorded by one of La Salle's party Joutel, with his account published in 1713.

Historians do not agree on the location of routes and places recorded by Joutel, and there is considerable conflict over the locale in Texas where La Salle was murdered, with Bolton (1924) placing La Salle's death on the Brazos near Navasota, Stiles (1906: 36) on a southern branch of the Trinity.

The most rigorous and careful account of La Salle's journey is given by Cole (1946). Cole uses Joutel's geological and geographic descriptions to trace the probable route. Evidently, La Salle journeyed up the Trinity in 1687 to a Cenis (Tejas)Indian village located at Wyser Bluff in Walker County between the East Sulphur and West Sulphur Creeks. The Trinity River was crossed and La Salle proceeded eastward toward the Neches. Yoakum (1855) would place the crossing and the Indian village near the town of Swartwout further south in Polk County. This locality is now innundated by Lake Livingston.

Rumors of French activity in East Texas stimulated the Spanish to increased exploration in Texas and within the Trinity Basin. In 1689, General Alonzo de Leon held an inquest of survivors of the Fort St. Louis camp, confirming rumors of French encroachment. In 1690, de Leon led an expedition to establish missions among the Tejas Indians, crossing the Trinity near the confluence of Boggy Creek and the Trinity in the southeastern corner of the present Leon County. The culmination of this journey was the establishment of mission San Francisco de los Tejas on San Pedro Creek in northeastern Houston County. The mission, under the direction of Padre Damien Massanet was abandoned in A.D. 1693 (Bolton 1916).

Conflict between French and Spanish interest waxed and wained until A.D. 1715 with no attempt at settlement by either.

In summary, the period from A.D. 1519 - A.D. 1715 is one of sporadic exploration. Although some knowledge of river systems in Texas was gained, the Lower Trinity Basin was simply a way station, crossed by French and Spanish parties at different times. The only remains offering any chance for archaeological field identification would have been the site of the Cenis (Tejas) Indian camp visited by La Salle in 1687. This camp is located probably at Wyser Bluff in Walker County or possibly near the later historic town of Swartout in Polk County.

Initial Settlement
A.D. 1715 - A.D. 1800

Open competition between the two European powers opened again in A.D. 1715, with the establishment of a French fort at Natchitoches, Louisiana, and the opening of trade relations with Indian groups in Texas. French activity provided the impetus for a concerted settlement effort on the part of both the Spanish government in Coahuila and Franciscan missionaries.

Between A.D. 1715 and 1774, a number of missions were established within east Texas in eastern Houston, Cherokee, Nacogdoches and San Augustine Counties, and along the San Gabriel River and Brushy Creek in the present Milam County (Bolton 1905: 73, Eckhart 1967: 73). A well traveled roadway, pioneered by a Frenchman Saint Denis in 1714, developed to connect mission and predisio complexes located east and west of the middle Trinity Basin. The road, known as the Old San Antionio or Presidio Road, ran from Natchitoches, Louisiana to San Antonio, crossing the Trinity in northeastern Madison County near the town of Midway (Garrison 1903:50).

No settlements were made in the Trinity Basin until A.D. 1755 or 1756 when a mission, Nuestra Señora de la Lay was established in Chambers County six miles south of Anahuac. The presidio of San Agustin de Ahumada near Wallisville was established at the same time (Bolton 1905: 73-74). The mission and presidio were abandoned in A.D. 1771.

Until 1774, no Spanish establishments were made in the middle Trinity Basin, although the Old San Antonio road was traveled across the area. The study area was occupied by several villages of Tawakoni Indians located in 1772 above Palestine (Hodge 1910) and probably near Tennessee Colony. The villages, composed of Yscanis and Tawakoni were apparently on both sides of the Trinity River, possibly near the confluence of Tehuacana Creek in Freestone and Anderson counties

(Brown 1925, Hokes 1936). A village of Kichais may also be present in Freestone County to the northeast of Butler, as well as a Kickapoo site in Leon County, west of Ninevah (Leathers 1946, Browne 1925: 10).

The beginnings of Spanish settlements in the middle Trinity Basin occurred in A.D. 1774 with the construction of a presidio, Nuestra Señor del Pilar de Bucareli on the Trinity River in Madison County. The exact location is a point of disagreement among historians with Gates and Fox (1936: 1) placing it near Midway, Bolton (1905), placing it on the right bank of the Trinity at the Old San Antonio Road Crossing, possibly at Bidais Creek dividing Madison and Walker Counties.

The presidio was evidently situated in a broad prairie with a number of Indian villages including Bidais, Tejas, Tonkawa and Tawakonis (Bolton 1914).

In summary, a number of Indian sites were located within the Middle Trinity between A.D. 1715 and 1800. Historical work places them in locales which would be affected by construction activities of the Corps of Engineers. Because these sites offer information on degree of early acculturation to the Spanish, efforts should be made to locate and salvage some of the data prior to construction. In addition, the Spanish presidio of Bucareli is within the area of canalization in Madison or Walker Counties.

The site is considered important by local historians and members of the Texas Archaeological Society, and considerable effort should be made to locate the site. Records indicate that Bucareli was occassionally flooded; thus it is within the floodplain and would be affected by canal activity.

Concentrated Settlement
AD 1800 - 1836

Concentrated Spanish settlement in the Middle Trinity Basin is a reflection of conflicts which developed between the Spanish and the United States over the boundary of the Louisiana Purchase.

Spain began to garrison East Texas to confirm its rights on the territory. In AD 1805, three companies of soldiers were stationed at Spanish Bluff, a large storehouse for operations on the east bank of the Trinity, a little below Robbins Ferry in Walker County (Crockett 1932: 69). By 1806, 400 soldiers were garrisoned at Spanish Bluff and 100 men at Robbins Ferry (Yoakum 1855). In AD 1812, an American expedition led by Magee took Spanish Bluff but the Spanish reoccupied it in 1813.

In addition to Spanish settlement on the Trinity, a number of Indian groups moved into the area (Burch 1950: 45, Houston 1938). A Cenis village located below Trinidad in Henderson County, a Coushatta group north of Liberty in the lower basin, and an Alabama village somewhere between. Locations are not concise enough for field survey at this time.

Although there are conflicts over the locations of Spanish Bluff and Robbins Ferry, because of the length of occupation and large size of the group, there appears to be a good possibility of locating the sites. Both sites are in the area of earlier Spanish activity (the Old San Antonio Road and Bucarelli) and field surveys could concentrate on several problems at the same time.

In AD 1819, James Long led an American party into Texas, stationing detachments at different points along the Trinity and Brazos Rivers. The expedition was short lived and no settlements were made within the Trinity Basin.

After the Florida Treaty of 1819, in which the United States relinquished claims to East Texas, and the subsequent ouster of Spain from Mexico in 1822, a change in relations occurred and Americans were encouraged to imigrate to Texas. The area of the Middle Trinity was out of the mainstream of events during much of the succeeding decade.

AD 1836 - 1860

The period from 1836 to about 1860 saw the development of the Middle Trinity. Much of the development was a consequence of steamboat transport from Galveston up the Trinity River. Some 54 ferrys and wharf complexes and towns were constructed between Liberty and Troy, a historic site below the confluence of Catfish Creek and the Trinity (Braman 1857: 165). As is true of most transport settlements, the towns were of some consequence, containing hotels, warehousing facilities, shops and other buildings. With the advent of railroads after the Civil War, the Trinity ceased to be a major transport artery and most of the sites were abandoned, with resident populations of storeowners and hotel keepers shifting to locales served by rail (Garrison 1930b).

The information below on historic events in the heyday of the Trinity is spotty, published histories are not available on some counties. In addition, many of the locations of sites are not precise enough to allow precise geographic determination.

NAVARRO COUNTY

Navarro County was created in 1846. History of the county essentially begins in 1836 when a grant of land was made to Colonel Robert Porter by the Texas Republic. Porter constructed a wharf and several buildings on the Trinity, which became known as Porter's Bluff about 2 miles south of the Ellis County line (Love 1933). In 1839, the town lost by only a few votes being the state capitol of Texas. A large townsite was laid out by John H. Reagan, a surveyor for Porter, adjacent to Porters Bluff. The town was named Taos and by 1866 had a 20 room hotel, several stores, a large wharf and ferry in addition to homes (Taylor 1962:60).

A number of other towns and ferrys were established within the county, prior to the Civil War, and included Trinity City south of Taos, Bazetto's Crossing, and Wild Cat Crossing. The latter site was established in northeast Navarro County by the Ingram brothers in 1850.

FREESTONE COUNTY

In 1825, the present area Freestone County was part of a land grant issued to Hayden Edwards by Mexico. The grant was revoked in 1826 and was issued to David G. Burnet. Prior to 1835 the only settlement was established by James Hall who built a trading post on the west side of the Trinity River. The site, just called Hall's Bluff, later became known as West Point, northeast of Butler.

After 1839, a rapid population increase occurred in the county. By 1846, a fairly sizable settlement had developed on the west side of the Trinity, east of the present town of Butler (Browne 1925:37). The town, originally called Pine Bluff later became known as Troy.

The site, located south of the town of Tennessee Colony and below the junction of Catfish Creek may be affected by canalization activity.

In 1851, a road was proposed linking Fairfield with Palestine in Anderson County with a ferry on the Trinity, designated as Wortham's (Browne 1925:57). A boat landing called Parkers Bluff was constructed in Anderson County in 1855; the landing was some 37 river miles south of Troy.

LEON COUNTY

A number of historic towns and ferrys, dating to the period of 1840 to 1860 are located along the Trinity River in Leon County. The more important of these would appear to be Port Cairo, the Port of Alabama southwest of Crockett in Houston County, Navarro, a river port in the northern part of Leon County, and Magnolia Ferry, built by John Shipler in 1847 in Northeast Leon County.

There were no permanent settlements in Leon County prior to 1840, although Robbins Ferry had been used by Texans to flee from the advancing Mexican army (Wood 1901: 203, Leathers 1946). The first port was Cairo, founded by a Captain Chandler and the Rodgers family in 1840 or 1841 due east of Guy's store and about 16 river miles south of Alabama in Houston County.

Other steamboat landings were established at Brookfield Bluff, some 20 miles north of Alabama Crossing, at Magnolia near the present town of Oakwood, and at Trinity City. No location is available on the latter town, although it was evidently the most important port (Leathers 1946).

Historic townsites within the Middle Trinity offer a rich storehouse for historical archaeological studies. The remains represent an era in Texas history, which has been little studied. The presence of these sites in close juxtaposition to Tennessee Colony Reservoir and proposed channelization areas would allow the development of historical exhibits.

Specific locations of most of the remains are somewhat questionable and will necessitate a good deal of contacts with present inhabitants of the concerned counties. In addition, through the use of Braman's (1857:164-5) itinerary of river routes from Galveston up the Trinity, a number of general localities could be spotted for field investigation. Braman report, published and the title "Braman's Information About Texas" by J. B. Lippincott. The following information on river miles is indicated:

1) Port of Liberty, Liberty County to Cincinnati Crossing in Walker County above Lake Livingston - 267 miles.

2) Cincinnati to Robbins Ferry in Madison County - 44 miles

3) Robbins Ferry to Cairo - 16 miles

4) Cairo to Alabama in Leon County - 16 miles

5) Alabama to Brookfield Bluff - 20 miles

6) Brookfield's Bluff to Kickapoo Shoals - 12 miles

7) Kickapoo Shoals to Magnolia - 66 miles

8) Magnolia to Pine Bluff (Troy) - 62 miles

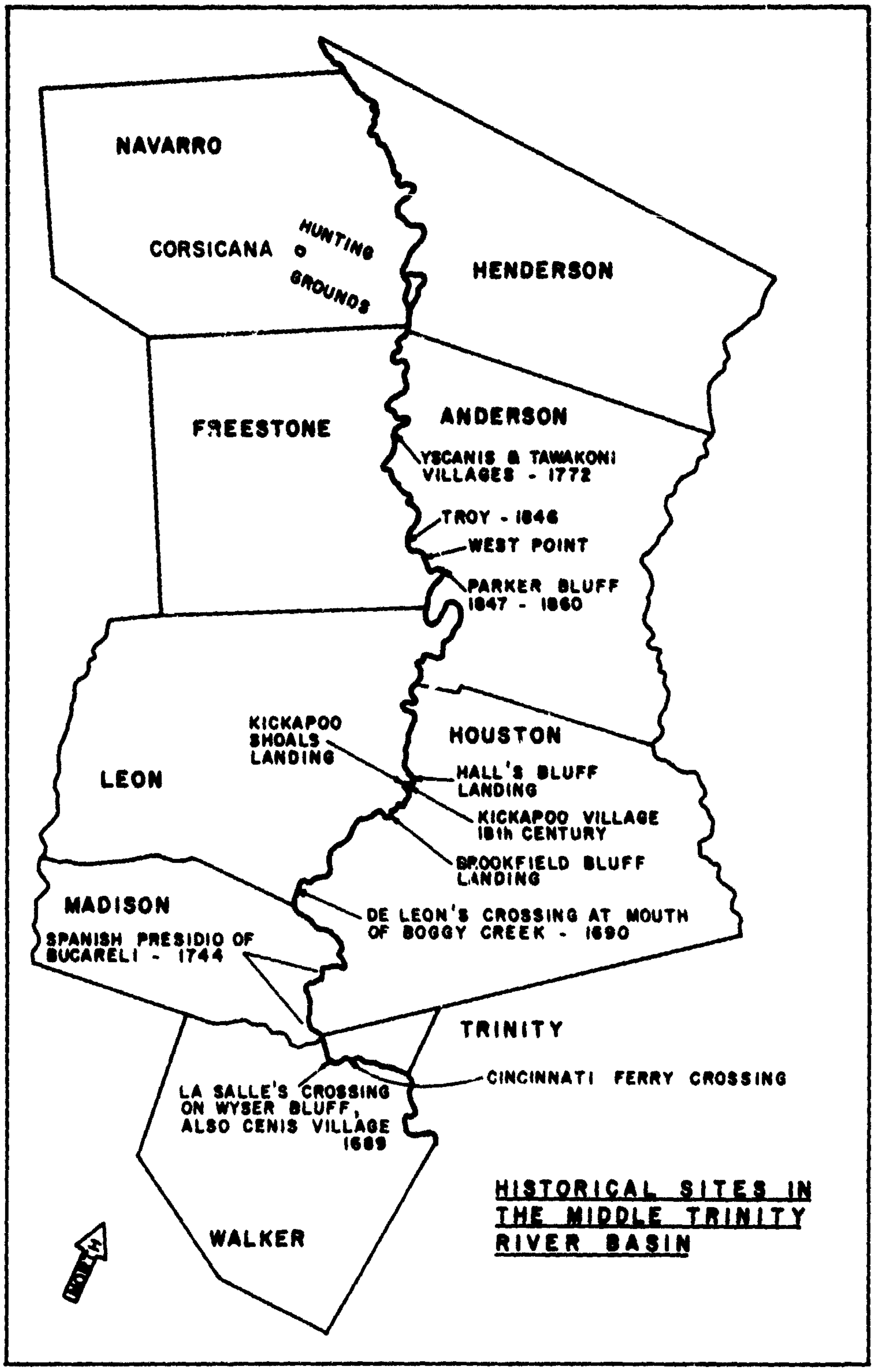

Figure 14. Historical sites in the Middle Trinity River Basin.

Summary

Review of the historical literature indicates that the Middle Trinity Basin contains a large number of historical sites, with Spanish, Anglo-American, as well as Indian remains represented. Although some Indian villages dated to the period of A.D. 1519 to A.D. 1715, might be encountered in field surveys, the majority of European activity in the area prior to 1774 is primarily of an exploratory nature, leaving few permanent alterations of the landscape. After this date, a number of settlements began to appear, initially with the establishment of the presidio of Bucarelli and later Spanish Bluff by the Spanish. Both sites are above Lake Livingston in the vicinity of the confluence of Bedias Creek and the Trinity.

The majority of historical sites are dated to the period after 1836, when the Middle and Lower Trinity blossomed as a major transport system. Although an attempt has been made to pinpoint the location of the wharf-ferry-town complexes, actual field investigation will be necessary to confirm documentary locations.

Because of historical importance of the sites and the possibility of developing historical exhibits as an adjunct to canalization and reservoir construction, it is recomended that the Corps of Engineers initiate field survey activity in the near future.

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CHAPTER VI

LITERATURE SURVEY OF THE PALEONTOLOGICAL RESOURCES OF THE TRINITY RIVER BASIN

by

David D. Gillette
Department of Geological Sciencies
Southern Methodist University

John T. Thurmond (honorary co-author)
Department of Geology
Birmingham Southern University
Birmingham, Alabama

LITERATURE SURVEY OF THE PALEONTOLOGICAL RESOURCES OF THE TRINITY RIVER BASIN

Field geology is often hampered by a dense cover of vegetation, making correlation and reconnaissance difficult at best. Few good exposures of bedrock are present in the Trinity River Basin, and still fewer are easily accessible. Exposures which are easily reached have been collected for fossils repeatedly, as attested by the accompanying abstracts of the literature. Others, less easily approached or less productive, have played an important role in surface correlation, providing information in the many long gaps between adequate exposures.

Geology and paleontology in the Trinity River Basin are locally well understood. However, serious gaps in our knowledge of stratigraphic relationships persist, even with the apparent abundance of collecting localities. The reasons are several, including less than satisfactory recording of locality data in published reports; concentration of studies in the more accessible areas, usually proximal to population centers; and an historical tendency for authors to hastily describe new species whenever a new formation or a new locality was found to be fossiliferous. The latter situation is presently being rectified with better understanding of population dynamics and ecological factors in fossil populations.

A glance at the abstracts will show that the majority of published information centers around larger metropolitan areas, such as Dallas and Tarrant Counties, while less heavily populated regions are poorly covered. Besides being less convenient for study, sparsely populated areas are generally uncleared, and they are often inaccessible except with special field equipment. It should be emphasized, however, that inaccessible regions are no less important than areas nearer to population centers.

The main emphasis of this report is an enumeration of the fossil localities of major importance in the Trinity Basin (Figs. 15 and 16). Most stratigraphically important outcrops are equally important as collecting localities for fossils, many being type localities for particular groups of organisms. Therefore, the central concern is to locate collecting sites for fossils, especially type localities and important measured sections. In the abstracts, only important localities and type localities have been listed, with the locations here recorded as accurately as in the reference.

The bibliography is arranged alphabetically by author and date, and the localities are numbered sequentially for the locality index maps (Tables 1 and 2).

Two persons deserve acknowledgement for their assistance. Dr. John T. Thurmond, now at Birmingham Southern College, Department of Geology, Birmingham, Alabama, and formerly of the Institute for the Study of Earth and Man, Southern Methodist University, is honorary co-author. In 1970 Dr. Thurmond conducted an extensive literature search for the Trinity Basin, in the broad sense, including all printed information on geology and related aspects within the basin. His computerized and annotated bibliography formed the initial and primary source for references in this report. From the 3300 entries in the unpublished Thurmond bibliography, some 500 proved directly important. The Thurmond bibliography was supported and directed by the far-sighted director of the Institute for the Study of Earth and Man, the late Dr. William B. Heroy, Sr., who provided the writer with Dr. Thurmond's bibliography and ample work space in the Institute for conducting this study. Dr. Heroy was most helpful and encouraging, and to him the writer is deeply indebted.

Introduction

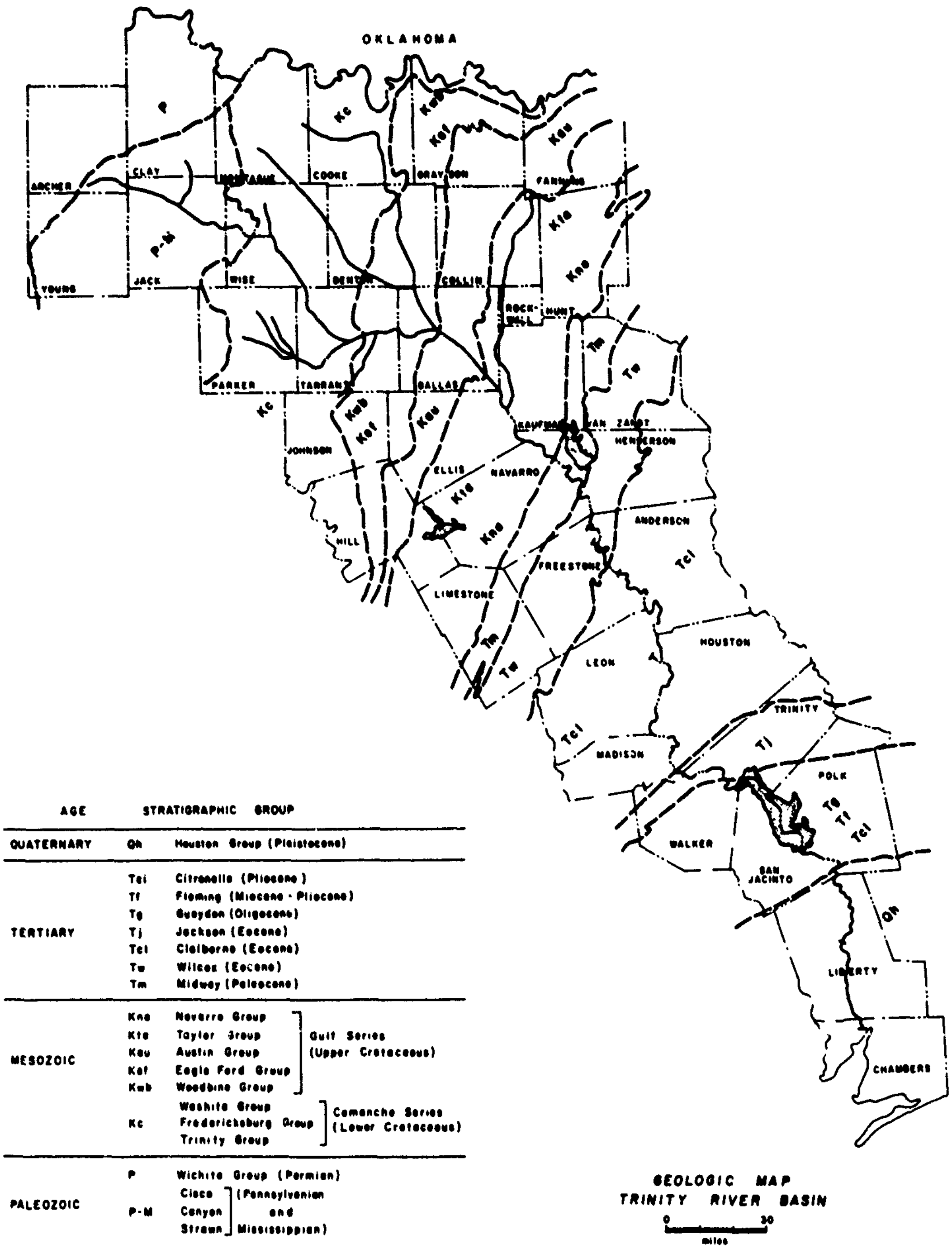
The northern portion of the Trinity River Basin includes bedrock of Paleozoic and Mesozoic age sediments. In the northwestern extreme of the basin, the older Permian sediments are overlain conformably by Pennsylvanian/Mississippian age carbonates and clastics. At the surface, these dip toward the northwest at a shallow angle, the outcrops trending roughly north-south. To the east and south, Cretaceous sediments lap unconformably onto the older Paleozoic rocks. These Cretaceous rocks are the oldest Texas remnants of the series of deposits accumulated during the retreat of the sea during the Mississippi Embayment. Beginning with Lower Cretaceous sediments in the north, the Trinity River passes over progressively younger Mesozoic and Cenozoic sediments to the south. All were deposited as sediments on the margin of the Gulf Coast Geosyncline. In the subsurface the formations generally thicken considerably toward the Gulf, approaching geosynclinal proportions at depth.

Paleozoic topography is variable, consisting largely of limestone-capped uplands standing as remnants of the once continuous veneer of the carbonate-shale-sandstone cover. From the Lower Cretaceous southward and eastward, topography consists of sets of gently rolling hills trending more-or-less perpendicular to the course of the Trinity River and forming long continuous cuestas on the up-dip sides of the exposures.

General Stratigraphy

Except for the Late Paleozoic sediments (Permian and Missippian-Pensylvanian) in the northwestern corner of the basin, surface exposures include a progression of Early Cretaceous formations in the north through a more-or-less complete representation of Tertiary formations to the south. Correlation is largely biostratigraphic rather than structural or lithologic.

A fair number of detailed stratigraphy papers have been published, although no single account has replaced the overall treatments of Dumble (1918) and Sellards, et al. (1932). Nearly all sedimentary rocks in the basin can be categorized as lowland terrestrial, shoreline, or near-shore deposits



AGE		STRATIGRAPHIC GROUP	
QUATERNARY	Qh	Houston Group (Pleistocene)	
TERTIARY	Tci	Citronelle (Pliocene)	
	Tf	Fleming (Miocene - Pliocene)	
	Tg	Gueydon (Oligocene)	
	Tj	Jackson (Eocene)	
	Tcl	Claiborne (Eocene)	
	Tw	Wilcox (Eocene)	
	Tm	Midway (Paleocene)	
MESOZOIC	Kna	Navarro Group	Gulf Series (Upper Cretaceous)
	Kta	Taylor Group	
	Kau	Austin Group	
	Kef	Eagle Ford Group	
	Kwb	Woodbine Group	
	Kc	Washita Group Fredericksburg Group Trinity Group	Comanche Series (Lower Cretaceous)
PALEOZOIC	P	Wichita Group (Permian)	
	P-M	Cisco Canyon Strawn	(Pennsylvanian and Mississippian)

Figure 15. Geologic map of the Trinity River Basin.

where the formations crop out at the surface. For this reason, all formations are potentially important for their fossil content, since these environments are the most likely to accumulate organisms in abundance. Especially important to paleontologists and stratigraphers are the following: the Permian "red-beds" region in the northwestern section of the basin for their terrestrian Paleozoic amphibians and reptiles (only a couple localities elsewhere in the world have proven as productive and as important to vertebrate evolution); the Lower Cretaceous formations in the northern and western part of the basin for their occasional ancestral mammal content; the Upper Cretaceous formations which were deposited in a shallow sea, for their invertebrate content, and for their large marine reptiles; the Paleocene-Cretaceous formational contact for purposes of correlation with other regions of the world; the Eocene and Middle Tertiary sediments for their invertebrate and vertebrate fossils; and the Quaternary formations, especially of Dallas and surrounding counties for their abundant vertebrate faunas of Pleistocene age.

A detailed account of all the formations in the basin is not feasible for this report. However, a general description of the formations of each age group follows:

Quaternary: strandline and nearshore deposits of Pleistocene age; stratigraphy poorly understood, based on coastline terrace levels according to sea level fluctuations during the last 2 million years; outcrops few; the area has been poorly surveyed for fossils; paleontology includes a poor representation of typical Pleistocene vertebrates and snails.

Middle and Late Tertiary: Oligocene, Miocene, Pliocene sediments, including a variety of terrestrial, shoreline, and nearshore deposits; stratigraphy incompletely understood, based in large part on vertebrate fossil correlation with continental Tertiary deposits, especially in north Texas sediments and in Kansas/Nebraska Tertiary sediments; outcrops few; early paleontological literature reflects a serious competition for vertebrate fossils with deliberately poor descriptions of localities; the few definitely known localities have been largely covered by aggradation during historic times due to agricultural and lumbering practices; the area has produced a large number of Tertiary fossils, now housed in many major museums around the country, without locality data; a concentrated survey for old and new localities in this area is a must if previously recovered fossils are to retain any value.

Early Tertiary: Eocene and Paleocene near-shore and terrestrial deposits; abundance of invertebrate fossil information, especially important to stratigraphy; only a few reported known sites of vertebrate fossil recoveries; potentially extremely important for its vertebrate content; the fossils are known to exist, but few concentrated efforts aimed at finding the localities have been conducted; outcrops few and difficult to reach in many places because of thick vegetation cover.

Included in the area of early Tertiary sediments is the region of the proposed Tennessee Colony dam in Anderson and Freestone Counties (see figures 15 and 16 for references and geology). This area is potentially the most important region in the basin with proposed construction projects. Tehuacana Creek, just north of the proposed dam site, has produced an abundance of invertebrate fossils, with many important type localities in the creek's drainage, all very important to stratigraphy. Moreover, there is a possibility that Eocene or Paleocene vertebrates are likely to be uncovered. Any vertebrate remains should be excavated at all cost, for here lies a possible Eocene or Paleocene vertebrate locality unique to all the world; only 4 or 5 other areas in the world have produced Paleocene vertebrates in any abundance, a situation which accounts for a poor understanding of early mammalian evolution.

Upper Cretaceous: Largely near-shore and offshore deposits of sandstones and limestones; stratigraphy fairly well known owing to abundant fossil content, especially foraminifera; includes occasional recoveries of large Mesozoic marine reptiles, important as representatives in an intermediate geologic and geographic position compared to areas of more abundant vertebrate recoveries; numerous type localities for invertebrates.

Lower Cretaceous: Near-shore and terrestrial deposits of sandstones, shales and limestones; stratigraphy poorly known for general lack of study and paucity of fossil material collected; fossil content in recent years has proven exceedingly productive for important groups of vertebrates (see various papers by Slaughter and Thurmond); important especially for early mammal recoveries; probably the poorest known region in the basin for its fossils despite the potential importance of Early Cretaceous fossils to paleontologists and stratigraphers.

Pennsylvanian-Mississippian: Largely offshore carbonates (limestone reefs), shales and sands; in the basin, these are an extension of a massive reef-complex to the south; many important invertebrates have been described from the areas to the south, while a lesser amount of concentration in the formations within the basin have yielded a small number of fossils; potentially important as a major tie-in with other continental Pennsylvanian sediments to the north.

Permian: Extends barely into the basin; includes a dominant terrestrial "red-bed" facies which has produced abundant numerous important terrestrial vertebrates; early locality data for this region is particularly difficult to decipher, when published, owing to a past of jealousy and possessiveness for the extremely important amphibian and reptile material recovered in the area.

Pleistocene Terraces of the Trinity River

Although the remnant terrace system along the Trinity River has been well studied in places (notably in Dallas County) little information has been gathered concerning Pleistocene terrace geology and paleontology along the river's entire course. Three remnant terraces are generally recognized, each with consistent elevations above present floodplain (conventionally numbered at T-0), and with distinct vertebrate and invertebrate faunas (Fig. 16).

The terrace geology is poorly understood with respect to sources for alluvial material. The most consistent mapping of terraces on the Trinity River relies on elevations, as follows:

T-0 Trinity River modern floodplain, approximately 20 feet above normal water level.

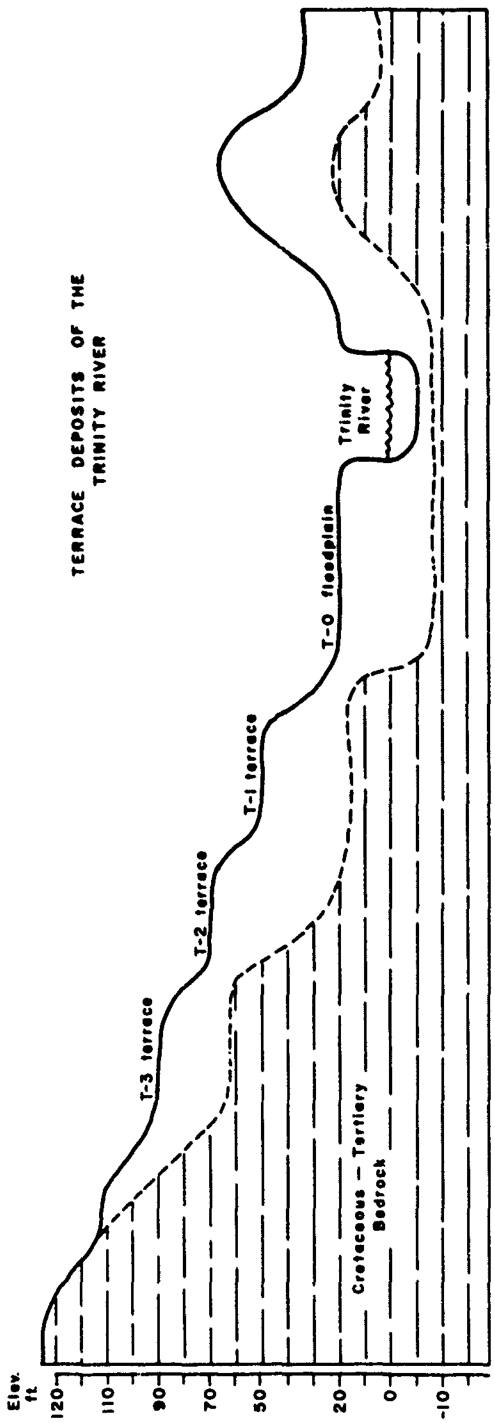


Figure 16. Terrace deposits of the Trinity River.

T-1 First terrace, often incompletely preserved owing to erosion; approximately 50 feet above river level.

T-2 Second terrace, generally present but not in full section; approximately 70 feet above river level.

T-3 Third terrace, never yet found in full section with associated fauna; often present as a cap on T-2 consisting of basal gravels and cobbles; difficult to recognize; minimum 90 feet above river level.

The ages of the terraces have been well established by faunal correlation and by radiocarbon dating:

T-0 5,000-2,000 B.P. (before present) to present; totally modern fauna.

T-1 10,000 B.P. to 4,000 B.P.; essentially modern vertebrate and snail faunas.

T-2 50,000 B.P. to 10,000 B.P.; early and middle Wisconsin age fauna; many extinct species; common mastodon, mammoth, bison, camel, horses, extinct deer, extinct giant land tortoise, extinct ground sloth.

T-3 In excess of 50,000 years before present; no associated fauna known.

These terraces have produced some of the best faunas for the late Pleistocene of North America. It is very likely that concentrated prospecting by experienced paleontologists will produce more (and hopefully better) terrace faunas south of Dallas County (Henderson County contains the only other well studied T-2 fauna in the south Trinity River drainage -- Stovall and McAnulty 1941). If the meagre, albeit important, information regarding the Trinity terrace is to retain any value, further exploration and mapping are essential, especially in areas to be excavated by construction or areas to be flooded.

TABLE 1. Cross Reference of Fossil Localities in the North Trinity River Basin by County and Abstract Number.

County	Abstract Locality Number	Total Localities
Archer	66, 67, 140, 280, 281, 282	6
Clay	140, 280	2
Montague	61-65, 114, 116, 251, 252, 253, 280, 336, 407	13
Cooke	4, 74, 149, 194, 195, 209, 326, 352, 363, 406	10
Grayson	4, 23, 74, 77, 83, 95-98, 210, 235, 244, 290, 307, 328, 336, 340, 348-352, 360, 362, 376-379, 382	30
Fannin	185, 290, 306, 323, 324, 338, 351, 352, 362, 365	10
Young	140, 279, 280, 281	4
Jack	106-109, 140, 141, 218, 280	8
Wise	4, 211, 218, 278, 297, 299, 345, 346, 363	9
Denton	4, 9, 14, 20, 68, 69, 75, 88, 93, 142, 165, 170, 179, 190, 192, 193, 197-201, 204, 211, 214, 223, 239-241, 254, 255, 296, 301, 344, 348, 351, 352, 404	37
Collin	21, 22, 78, 154, 166, 181, 322, 337, 353, 362, 366, 385	12

TABLE 1 continued

County	Abstract Locality Number	Total Localities
Hunt	180	1
Parker	4, 74, 211, 347, 363	5
Tarrant	4, 11, 15-19, 24, 48-50, 70, 71, 74, 89-92, 94, 111, 112, 148, 151, 155, 161, 185-189, 191, 196, 203, 205-208, 211, 215, 216, 219, 221, 222, 230-233, 248, 249, 256-260, 266, 283-288, 292, 293, 324, 325, 327, 348, 351, 352, 359, 363, 380, 381, 383, 390-402	88
Dallas	10, 13, 84, 110, 150, 156, 162, 167, 171, 174-176, 212, 220, 226-229, 242, 243, 245-247, 261, 291, 294, 295, 298, 321, 333-335, 348, 362, 364, 367, 371-373, 387-389	42
Rockwall	21, 22, 78, 154, 166, 181, 322, 337, 353, 362, 366, 385	12
Kaufman	25, 58-60, 130, 131, 143, 144, 178, 225, 330, 362	12
Johnson	4, 74, 202, 217, 234, 352, 403	7
Ellis	7, 8, 73, 157, 163, 224, 236-238, 262, 302-304, 334, 339, 368-370	18
Hill	3, 352, 405	3

TABLE 2. Cross Index of Fossil Localities in the South Trinity Basin by Literature Number and County.

County	Abstract Locality Number	Total Localities
Navarro	1, 5, 6, 12, 27, 79, 80, 82, 86, 103, 158, 168, 316, 341-343, 355, 357, 374, 386	20
Henderson	42, 272, 354	3
Limestone	26, 28, 76, 81, 87, 104, 132-134, 184, 263, 264, 320, 375	14
Freestone	30, 31, 113, 125, 145, 356	6
Anderson	29, 55, 56, 57, 99, 127, 135-137, 172	10
Leon	53, 54, 105, 124, 126, 139, 250, 265, 309, 311-314, 317, 329, 331	16
Houston	36-40, 51, 52, 100-102, 117-122, 128, 129, 138, 146, 147, 177, 308, 310, 315, 318, 319, 332	28
Trinity	32-35, 45, 47, 123, 152, 159, 173	10
Walker	43, 44	2
San Jacinto	153, 169, 183, 268, 269, 361	6
Polk	41, 46, 160, 164, 267, 289	6
Chambers	275, 276	2

Paleontological Abstracts

Adkins, W. S., 1928, Handbook of Cretaceous Fossils, University of Texas Bulletin No. 2838, 385 pp., 37 pls.

Abstract: Impossible to list all the localities; this is an indispensable reference for anyone working in the Cretaceous of Texas with invertebrate fossils and (less important) with vertebrate fossils and plants; arranged according to taxon.

Localities: Locality information not arranged systematically.

Adkins, W. S., 1929, Some Upper Cretaceous Taylor ammonites from Texas, University of Texas Bulletin No. 2901, pp. 203-222, 2 pls.

Abstract: Description of ammonites and associated fauna.

Localities:
(1) From upper Taylor Formation about 5 miles west of Emhouse, Navarro County.
(2) Also material collected from Taylor Formation in Travis County.

Adkins, W. S. and F. E. Lozo, 1951, Stratigraphy of the Woodbine and Eagle Ford, Waco area, Texas in Lozo and Perkins, eds., The Woodbine and adjacent strata of the Waco area of central Texas, a symposium, Fondren Science Series, No. 4, pp. 101-164, illus., maps.

Abstract: Review of earlier work, discussion of fossil zonation and stratigraphy of the Woodbine and Eagle Ford Formations.

Localities:
(3) Hill County, southwestern portion of Alligator Creek locality, measured section, 112 feet Woodbine Sandstone.

Adkins, W. S. and W. M. Winton, 1920, Paleontological Correlation of the Fredericksburg and Washita formations in north Texas, University of Texas Bulletin No. 1945, 128 pp., 22 pls., 6 figs.

Abstract: A detailed biostratigraphic treatment; a classic foundation for later studies.

Localities:
(4) Locality information not systematically arranged; many type localities Cooke, Grayson, Wise, Denton, Parker, Tarrant, Hood and Johnson Counties.

Albritton, C. C., Jr. and F. B. Phleger, Jr., 1937, Foraminiferal Zonation of certain Upper Cretaceous clays of Texas, Journal of Paleontology, Vol. 11, No. 4, pp. 347-354.

Abstract: Faunal zonation in foraminifer rich Upper Cretaceous clays; description of the fauna, discussion, distinguishing features, faunal list.

Localities:
(5) Navarro County: clay pit of the Corsicana Brick and Lumber Company, Corsicana.
(6) Navarro County: clay pit of the Whitesell Brick and Lumber Company, Corsicana.
(7) Ellis County: clay pit west of Southern Pacific Railroad, Ferris.
(8) Ellis County: clay pit east of the Southern Pacific Railroad, Ferris.

Albritton, C. C. Jr., W. W. Schell, C. S. Hill and J. R. Puryear, 1954, Foraminiferal Populations in the Grayson Marl, G.S.A. Bulletin, Vol. 65, No. 4, pp. 327-336, illus.

Abstract: Population analysis and paleoecological interpretations based on the Upper Cretaceous foraminifers recovered from the Grayson Marl.

Localities:
(9) Grayson Bluff, Denton County

Albritton, C. C. Jr. and L. S. Patillo, Jr., 1940, A Human Skeleton Found Near Carrollton, Texas, Field and Laboratory, Vol. 8, pp. 59-64, illus., map.

Abstract: Interpreted as human burial.

Localities:
(10) On north side of the Carrollton-Denton highway, 1.1 miles by road west of Carrollton dam (accompanying index map).

Alexander, C. I., 1931, A New Lower Cretaceous ophiuroid, Journal of Paleontology, Vol. 5, No. 2, pp. 152-153, 1 text-fig.

Abstract: New species of ophiuroid, or "serpent star" from two slabs of limestone in the Grayson formation near Everman, Texas. Other fossils well preserved there also.

Localities:
(11) "from a thin ledge at the base of the Grayson in an exposure on the east bank of Village Creek, about 100 yards south of the bridge which crosses the creek, 2 miles east of Everman on the Everman-Kennedale Road", Tarrant County.

Alexander, C. I., 1932, Sexual dismorphism in fossil Ostracoda, American Midland Naturalist, Vol. 13, No. 5, pp. 302-311, 1 pl.

Abstract: Devoted to correcting earlier errors in describing as separate species the male and female representatives of the same species and to outlining the morphological features distinguishing the sexes in ostracods.

Localities:
(12) Navarro County, at an exposure of Navarro clays in an abandoned clay pit 2 miles south of Corsicana.
(13) Dallas County, an exposure of upper Austin chalk in the bank of a small gully a few feet west of a concrete culvert on the Dallas-Garland highway,

at a point 3.4 miles northeast of Whiterock Dam.

(14) Denton County, an exposure of the Grayson clays in a high bluff on the north bank of Denton Creek, about 4 miles northeast of Roanoke.

(15) Tarrant County, about 4 miles northeast of Roanoke, Texas at Cragins Knobs, on the Stove Foundry road, 3 miles west of the new Texas and Pacific railroad shops in Fort Worth.

Alexander, C. I., 1933, Shell Structure of the Ostracode Genus Cytheropteron and Fossil Species from the Cretaceous of Texas, Journal of Paleontology, Vol. 7, No. 2, pp. 181-214, 3 pls.

Abstract: Morphology of the shell of these ostrocods and description of two genera and several species.

Localities:

(16) No. 2302: Upper Goodland limestone and marl in a roadcut which truncates 3 small rounded spurs known as "Cragin's Knobs", 3 miles west of the Texas and Pacific Railroad shops in Fort Worth on the Stove Foundry Road. Type locality for 8 species, Tarrant County.

(17) No. 2305: A deep roadcut just north of the Texas and Pacific Railroad shops, Fort Worth, Texas (type locality), Tarrant County.

(18) No. 2325: In the bank of a small gully which flows northward to empty into a tributary of Sycamore Creek, about 1/4 mile below (east of) the point where the stream has been damed to form "Katy Lake", south of Fort Worth, Tarrant County (type locality).

(19) No. 2326: In a roadside ditch along the west side of the gravelled road which leads from the old Fort Worth-Burleson highway to the town of Everman, about 1/4 miles southeast of the intersection of the two roads and about 400 feet south of a bridge where the Everman road crosses a small stream; Tarrant County.

(20) No. 2438: In a high steep bluff on the west bank of Indian Creek, at a point about 6 1/2 miles east of the railroad crossing at Lewisville (type locality), Denton County.

(21) In a large abandoned clay pit of the Corsicana Brick Company, 2 miles south of Corsicana, Collin County (type locality).

Alexander, C. I., 1934a, Ostracoda of the Genera Monoceratina and Orthonotacythere from the Cretaceous of Texas, Journal of Paleontology, Vol. 8, No. 1, pp. 57-67, 1 pl.

Abstract: Detailed accounts for both genera. Eight new species described and figured.

Localities (in basin):
(22) "at an exposure of upper Austin chalk in a deep road cut on the Dallas-Sherman highway, at the southern edge of the city of McKinney, Collin County."
(23) "at an exposure of lower Gober chalk in a road-side ditch along the north side of the road which leads eastward from Van Alstyne to the Whiteright-Blue Ridge highway, at a point 3.7 miles east of Van Alstyne, Grayson County."
(24) "at an exposure of upper Weno limestone and marl in a roadside ditch 0.3 mile south of the bridge which crosses Sycamore Creek on the Fort Worth-Mansfield highway, near the Glen Garden Country Club, Fort Worth, Tarrant County."
(25) "at an exposure of Taylor clays, in a shallow roadside ditch along the north side of the Forney-Rockwall road, 2.3 miles northwest of the intersection of the 2 main streets in the business district of Forney, Kaufman County."

Alexander, C. I., 1934b, Ostracoda of the Midway (Eocene) of Texas, Journal of Paleontology, Vol. 8, No. 2, pp. 206-237, 1 fig., 4 pls.

Abstract: Now considered Paleocene; description of an ostracod fauna from 22 localities; an important stratigraphic work.

Localities:
(26) Limestone County, exposure in field about 2 miles east-northeast of Honest Ridge School southwest of Mexia, about 3/4 mile south of Big Williams

Well and approximately 3 1/2 miles north of Groesbeck.

(27) Navarro County, south bank of Foggyhead Creek in Smith's pasture about 0.15 mile west of the bridge on the Kerens-Round-Prairie road, 3.8 miles by road south-southeast of the railroad station in Kerens.

(28) Limestone County, steep bank along east side of tributary running due north into Tehuacana Creek about 2 miles in a direct line north and slightly west of the center of the town of Mexia.

Ball, O. M., 1931, A Contribution to the Paleobotany of the Eocene of Texas, Texas Agricultural and Mechanical College Bulletin, 4th Series, Vol. 2, No. 5, 173 pp., 8 figs., 48 pls.

Abstract: An impressive detailed account of the Eocene paleobotany of Texas, with many new species and genera; extremely comprehensive including geology of the Coastal Plain, stratigraphy, geological history, paleontology (botany and insects); many localities but poorly located.

Localities:

(29) Anderson County, Post Oak Prairie 2 miles south of Needmore.

(30) Freestone County, from the Butler of West Point salt dome 6 miles northeast of Oakville.

(31) Freestone County, Midway Formation

(32) Trinity County, Catahoula Sandstone

(33) Trinity County, Fayette Sandstone 3/4 mile above junction of Caney and White Rock Creeks.

(34) Trinity County, Rocky Mound

(35) Trinity County, Government Lock, Catahoula Sandstone

(36) Houston County, on Cedar Creek

(37) Houston County, Westmoreland and Vicinity

(38) Houston County, Nevils Prairie

(39) Houston County, Antioch

(40) Houston County, Palestine Mt. Selman Formation

(41) Polk County, Stryker, Catahoula Sandstone

Ball, O. M., 1939, A Contribution to the Paleobotany of the Eocene of Texas, Part 2, Texas Agricultural and Mechanical College Bulletin, 4th Series, Vol. 10, No. 3, 54 pp., 13 pls., 1 fig.

Abstract: Basically a continuation of Ball, 1931; comprehensive account of more stratigraphy, paleontology, geology; several new species.

Localities:
(42) Henderson County, in outskirts of Athens, in the works of the Athens Clay and Tile Company, oval excavation pit.
(43) Walker County, Wynne Quarry
(44) Walker County, Harmon's Creek
(45) Trinity County, Fayette Sandstone
(46) Polk County, Harmon's Creek
(47) Trinity County, Rocky Mound

Barker, R. W., 1944, Some Larger Foraminifera from the Lower Cretaceous of Texas, Journal of Paleontology, Vol. 18, No. 2, pp. 204-209, illus.

Abstract: Review of large Texas foraminifera. Description of one new species.

Localities:
(48) Some from Fort Worth region, Tarrant County.

Beddoes, L. R. Jr., 1956, Foraminiferal Populations of the Goodland Formation, Tarrant County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 35 pp., 5 text-figs., 2 tables.

Geology of the Oak Cliff Quadrangle, Dallas County, Texas, Field and Laboratory, Vol. 21, pp. 34-43, 2 text-figs.

Abstract: Discussion of the Austin Formation and Quaternary terraces.

Berry, C. T., 1941, Cretaceous Ophiurans from Texas, Journal of Paleontology, Vol. 15, No. 1, pp. 61-67, illus.

Abstract: Redescription of two species and description of one new species (only 3 known species in Texas Cretaceous).

Localities:
(49) Six miles north of Fort Worth, on the banks of Fossil Creek (Denison Formation) Tarrant County.
(50) East bank of Village Creek, 100 yards south of bridge, 2 miles east of Everman-Kennedale road, southeast of Fort Worth, Tarrant County.

Bilelo, M. A. M., 1967, Fusilinidae of the Winchell Formation, (Pennsylvanian) in the Brazos River Valley and Part of the Trinity River Valley, North-central Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 55 pp., 6 pls., 6 tables, 2 text-figs.

Bowles, E. O., 1939, Eocene and Paleocene Turritellidae of the Atlantic and Gulf Coastal Plain of North America, Journal of Paleontology, Vol. 13, No. 3, pp. 267-336, 4 pls.

Abstract: Taxonomy of the family of snails and description of 17 new species; several type localities within basin.

Localities:
(51) Houston County, Alabama Crossing on Trinity River 10 miles west of Porter Springs.
(52) Houston County, water well at Percilla
(53) Leon County, Two-mile Negro Church, 3-4 miles south of Middleton.
(54) Leon County, 1/2 mile east of Robins on Centerville Road.
(55) Anderson County, 1 1/2 miles southeast of Palestine on Boston Road.
(56) Anderson County, 11.5 miles north of Grapeland on the Palestine Road.
(57) Anderson County, small creek northeast of lignite mine on property of Palestine salt works, Palestine.

(58) Kaufman County, 4 miles northeast of Kemp
(59) Kaufman County, Water Hill 5 miles northeast of Kemp
(60) Kaufman County, quarry south of Ola

Brian, W., 1952, Geology of the Oak Cliff Quadrangle, Dallas County, Texas, Field and Laboratory, Vol. 21, pp. 34-43, 2 text-figs.

Bullard, F. M., 1931, The Geology of Grayson County, Texas, University of Texas Bulletin No. 3125, 72 pp., 4 figs., map.

Abstract: General account. Measured sections and fossil localities. Should be re-examined for fossils and re-described, Grayson County.

Bullard, F. M. and R. H. Cuyler, 1930, A Preliminary Report on the Geology of Montague County, Texas, University of Texas Bulletin No. 3001, pp. 57-76, 1 fig., 1 pl., map.

Abstract: A very preliminary report with several measured sections.

Localities (measured sections with invertebrate fossils):
(61) South side of Big Sandy Creek, 1 1/2 miles west of the Chicago, Rock Island and Pacific Railroad crossing, Montague County.
(62) Six miles south of Bowie, and 1 1/2 miles south of the crossroad between the Brian Creek-Selma Road and the Rock Hill school road, Montague County.
(63) On road one mile west of Forestburg, Montague County.
(64) One-half mile west of Dye Mound, Montague County.
(65) On the Forestburg-Gainesville Road about 5 miles south of Forestburg, Montague County.

Bybee, H. P. and F. M. Bullard, 1928, The Geology of Cooke County, Texas, University of Texas Bulletin No. 2710, pp. 5-61, 6 figs., 10 pls., including map.

Abstract: Detailed account of the physiography, stratigraphy, structure, paleontology, mineral resources and petroleum developments of the County. Numerous measured sections, Cooke County.

Case, E. C., 1935a, Description of a Collection of Associated Skeletons of Trimerorhachis, Michigan University Museum of Paleontology Contributions, Vol. 4, No. 13, pp. 227-274, 29 figs., 11 pls.

Abstract: Description of a truly phenomenal assemblage of 16 Trimerorhachis (a large Permian amphibian) skulls and associated skeletal material in a single slab, plus debris from the slab containing 8 other skulls and other skeletal material; basically a clarification of the osteology of this important genus based on this fortunate recovery.

Localities:
(66) Permo-Carboniferous beds of north-central Texas, Archer County.

Case, E. C., 1935b, A New Paleoniscid Fish, Eurylepoides socialis, from the Permo-Carboniferous of Texas, Michigan University Museum of Paleontology Contributions, Vol. 4, No. 14, pp. 275-277, 1 fig.

Abstract: Description of a new species of an early archaic fish of late Paleozoic age.

Localities:
(67) Near Dundee, Archer County

Caster, K. E., 1944, Hydrozoan Jellyfish from the Lower Cretaceous of Texas (abs.), Geological Society of America Bulletin , Vol. 55, No. 12, p. 1465.

Abstract: Report of the first occurrence of jellyfish in the American Mesozoic; important discovery for the understanding of a major invertebrate group.

Localities:
(68) From the Pawpaw formation, Denton County.

Caster, K. E., 1945, A New Jellyfish (Kirklandia texana Caster) from the Lower Cretaceous of Texas, Palaeontographica Americana, Vol. 3, No. 18, 52 pp., illus.

Abstract: Description of a new family of Cretaceous jellyfish; a rare group in North America which nevertheless shed some light on European problems regarding jellyfish evolution.

Localities:
(69) Two miles west of Roanoke, Denton County (type locality).

Clark, D. L., 1959, Texas Cretaceous Ophiuroids, Journal of Paleontology, Vol. 33, No. 6, pp. 1126-1127.

Abstract: Invertebrate fossils.

Localities:
(70) "a locality in the Weno (Lower Cretaceous) just south of Fort Worth, Tarrant County."
(71) "from the Grayson (Upper Cretaceous) of the Fort Worth area, Tarrant County."
(72) "in the Navarro (Upper Cretaceous) of Travis County."
(73) northern Ellis County south of Dallas

Cooke, C. W., 1946, Comanche Echinoids, Journal of Paleontology, Vol. 20, No. 3, pp. 193-237, illus.

Abstract: Major revision of the Cretaceous sea urchins of the Gulf states, the southern Great Plains, and southern New Mexico and Arizona, dealing mainly with echinoids of Texas, Oklahoma, Arkansas and Mexico.

Localities:
(74) Many localities: Grayson, Tarrant, Johnson, Parker and Cooke Counties; locality data not precise.

Crook, W. W. and R. K. Harris, 1958, A Pleistocene Campsite Near Lewisville, Texas, American Antiquity, Vol. 23, No. 3, pp. 233-246, illus.

Abstract: Archaeological and paleontological assemblage with discussion and implications.

Localities:
(75) In extreme southeast Denton County, on the west side of the Elm Fork of the Trinity River, just north of Lewisville, Denton County.

Cummins, W. F., 1898, The Localities and Horizons of Permian Vertebrate Fossils in Texas, Journal of Geology, Vol. 16, pp. 737-745.

Abstract: One of the few papers on Texas Permian vertebrates which is not secretive about the collecting localities in the red-beds region. Description of many collecting sites, immediately adjacent to, and partly overlapping, the Trinity River drainage. Clay, Jack, Archer, Young Counties.

Cushman, J. A., 1930, Notes on Upper Cretaceous Species of Vaginulina, Flabellina, and Frondicularia from Texas and Arkansas, Cushman Laboratory Foraminifera Research Contributions, Vol. 6, Part 2, pp. 25-38, 2 pls. (Contribution 90).

Abstract: Descriptions of several new species of Foraminifera, important to stratigraphy; one locality in basin.

Localities:
(76) Limestone County, from the Navarro in the marl above the Nacotoch sand, Mexia highway, 2.8 miles east of Cooledge.

Cushman, J. A., 1931, Hastigerinella and Other Interesting Foraminifera from the Upper Cretaceous of Texas, Cushman Laboratory Foraminifera Research Contributions, Vol. 7, Part 4, pp. 83-90, plate 11 (Contribution 114).

Abstract: Discussion of several types of foraminifera with descriptions of three new species.

Localities:
(77) Near the northern edge of the town of Howe, Grayson County.

Cushman, J. A., 1932, _Textularia_ and Related Forms from the Cretaceous, Cushman Laboratory Foraminifera Research Contributions, Vol. 8, Part 4, pp. 86-97, 1 pl. (Contribution 124).

Abstract: Clarification of a group of similar foraminifera and descriptions of new forms; important to stratigraphy; two type localities in basin.

Localities:
(78) Collin County, 5.1 miles from Josephine along the highway to Nevada.
(79) Navarro County, 6 miles east of Corsicana.

Cushman, J. A., 1940a, American Upper Cretaceous Foraminifera of the Genera _Dentalina_ and _Nodosaria_, Cushman Laboratory Foraminifera Research Contributions, Vol. 16, Part 4, pp. 75-96, illus. (Contribution 223).

Abstract: Discussion of the foraminiferal population of these genera in the Upper Cretaceous sediments of North America; four type localities in basin.

Localities:
(80) Navarro County, clay pit 2 miles south of Corsicana Court House.
(81) Limestone County, Mexia highway at forks of Wortham Road, 2.8 miles east-southeast of Cooledge.
(82) Navarro County, road ditch 3.5 miles northwest of Union Seminary School, 4.3 miles south-southeast of Corbet.
(83) Grayson County, on road at north edge of Whiteright, north-facing slope of branch valley.

Cushman, J. A., 1940b, American Upper Cretaceous Foraminifera of the Family Anomalinidae, Cushman Laboratory Foraminifera Research Contributions, Vol. 16, Part 2, pp. 27-40, illus. (Contribution 218).

Abstract: Descriptions of representatives of this family, some of which are particularly useful as index fossils.

Localities:
(84) Roadcut, south side of U.S. highway 80, 2 feet above sidewalk, opposite Catholic school, 3.8 miles west of Union Station, Dallas, Dallas County.
(85) North of Sulphur Creek, 2.3 miles southeast of Gober, Fannin County.
(86) 2.6 miles east of Barry, on road to Corsicana, Navarro County.

Cushman, J. A., 1941, American Upper Cretaceous Foraminifera Belonging to Robulus and Related Genera, Cushman Laboratory Foraminifera Research Contributions, Vol. 17, Part 3, pp. 55-69, illus. (Contribution 230).

Abstract: Discussion of the Robulus group of foraminifera from the Coastal Plain Cretaceous; one definite locality in basin.

Localities:
(87) Limestone County, Mexia highway at forks of Wortham Road 2.8 miles east-southeast of Cooledge.

Cushman, J. A. and C. I. Alexander, 1930, Some Vaginulinas and Other Foraminifera from the Lower Cretaceous of Texas, Cushman Laboratory Foraminifera Research Contributions, Vol. 6, Part 1, pp. 1-10, 2 pls. (Contribution 87).

Abstract: Discussions of forams of this type, with descriptions of five new species.

Localities:
(88) Near the Fort Worth-Denton contact, 1.5 miles west of Krum, Denton County.
(89) In the Denton, 5 miles south of Fort Worth, Tarrant County.
(90) In the Weno, 5 miles south of Fort Worth, Tarrant County.
(91) At Cragins Knobs, 6 miles west of Fort Worth, Tarrant County.
(92) At Lake Worth Dam near Fort Worth, Tarrant County.
(93) West of Sanger, Denton County

Cushman, J. A. and E. R. Applin, 1946, Some Foraminifera of the Woodbine Age from Texas, Mississippi, Alabama and Georgia, Cushman Laboratory Foraminifera Research Contributions, Vol. 22, Part 3, pp. 71-76, illus. (Contribution 279).

Abstract: Clarification of several forms, and description of four new species.

Localities:
(94) "in a valley tributary to the Trinity River near the east edge of Tarrant County; a four foot exposure below ledge of fossiliferous "Tarrant" limestone in creek bank, 50 feet south of dike of earthen stock tank and about 800 feet north of Dorothy Switch."
(95) "from an eroded hillside along old highway approximately 2 miles east of Whitesboro, Grayson County."
(96) "exposed on a hillside above a small pond, 0.9 mile south 45° west of the center of Loy State Park Lake, 2 miles southwest of Denison, Grayson County."

Cushman, J. A. and E. R. Applin, 1947, Some New Foraminifera from the American Cretaceous, Cushman Laboratory Foraminifera Research Contributions, Vol. 23, Part 3, pp. 53-55, illus. (Contribution 293).

Abstract: Description of six new species.

Localities:
(97) 3 1/2 miles southeast of Gordonville, Grayson County.
(98) 2 miles east of Whitesboro, Grayson County.

Cushman, J. A. and N. L. Thomas, 1929, Abundant Foraminifera of the East Texas Greensands, Journal of Paleontology, Vol. 3, No. 2, pp. 176-194, 2 pls.

Abstract: Description of the East Texas Eocene foraminiferan fauna; one locality in basin.

Localities:
(99) Anderson County, one mile north of Elkhart near the railroad at Hopkins fault.

Cushman, J. A. and N. L. Thomas, 1930, Common Foraminifera of the East Texas Greensands, Journal of Paleontology, Vol. 4, No. 1, pp. 33-41, 2 pls.

Abstract: Descriptions of the most common Eocene foraminifera of the area; important to stratigraphy.

Localities:
(100) Houston County, 4 miles east of Grapeland.
(101) Houston County, from the Mt. Selman Formation at San Pedro Creek, Brown Farm on Augusta Road east of Grapeland.
(102) Houston County, from the Cooks Mountain Formation, Brookfield Bluff, 14 miles west of Crockett on the Trinity River.

Cushman, J. A. and M. R. Todd, 1943, Foraminifera of the Corsicana Marl, Cushman Laboratory Foraminifera Research Contributions, Vol. 19, Part 3, pp. 49-72, illus. (Contribution 246).

Abstract: Detailed study of the foraminiferal fauna of the Upper Cretaceous Corsicana Marl.

Localities:
(103) Navarro County, the pit of the Corsicana Brick Company, 2 miles south of the Corsicana Courthouse (type locality for the formation).
(104) Limestone County, from the Mexia highway at the forks of the Wortham road, 2.8 miles east-southeast of Cooledge.

Cushman, J. A. and J. A. Waters, 1929, Some Arenaceous Foraminifera from the Taylor Marl of Texas, Cushman Laboratory Foraminifera Research Contributions, Vol. 5, Part 3, pp. 63-66, 1 pl. (Contribution 82).

Abstract: Description of 4 new species; one type locality in basin, other in subsurface.

Localities:
(105) Leon County, Marquez Dome

Cushman, J. A. and J. A. Waters, 1930, Foraminifera of the Cisco Group of Texas (exclusive of the Fusilinidae), University of Texas Bulletin No. 3019, pp. 22-81, 11 pls., index, maps.

Abstract: Systematics and descriptions of forams of these Pennsylvanian and Permian sediments. Four localities in the Trinity Basin.

Localities:
(106) C-4: 3.4 miles by road southeast of the courthouse in Jacksboro. Exposure in the G.T. and W. Railway cut west of the viaduct on the Jacksboro-Perrin road, Jack County.
(107) C-5: Same railway as C-4 (above) but east of the viaduct, where an exposure of white limestone is underlain by calcareous shale, Jack County.
(108) C-6: 3.7 miles by road southeast of the courthouse in Jacksboro, where a viaduct spans the Rock Island Railway cut in which is an exposure of shale, Jack County.
(109) C-13: 1/2 mile south of Jacksboro on the Jacksboro-Perrin road, Jack County.

Dallas Petroleum Geologists, 1941, Geology of Dallas County, Texas, Field and Laboratory, Vol. 10, No. 1, pp. 1-134, illus., index and geol. map.

Abstract: Although now outdated by subsequent works, this report provides a sound framework for the general geology of the county; includes information on the type localities for the following formations: Eagle Ford, Austin, Taylor; extensive bibliography.

Localities:
(110) Eagle Ford Formation type locality: named for exposures around the small settlement of Eagle Ford, on the south side of the Trinity north of Arcadia Park, Dallas County.

Davidson, E., 1963, New Linuparid Crustaceans from the Upper Cretaceous of Texas, Bulletins of American Paleontology, Vol. 46, No. 206, pp. 65-76, 1 pl.

Abstract: Description of two species, one new, of the genus Linuparus, from the Upper Cretaceous of Texas.

Localities:
(111) In a road cut located on highway 360 two miles south of its junction with highway 183, Tarrant County.
(112) Along the banks of Rush Creek about five miles southwest of Arlington, Tarrant County.

Davidson, E., 1966, A New Paleocene Crab from Texas, Journal of Paleontology, Vol. 40, pp. 211-213, illus.

Abstract: Description of a new genus and species; type locality.

Localities:
(113) Freestone County, in the Paleocene Wills Point Formation, 7 miles northwest of Streetman.

Dodge, C. F., 1969, Stratigraphic Nomenclature of the Woodbine Formation, Tarrant County, Texas, Texas Journal of Science, Vol. 21, pp. 43-62, map.

Abstract: Clarification of the stratigraphy of the Woodbine Formation in Tarrant County. Detailed measured sections of six exposures. An excellent model for future workers to follow; should be consulted before doing any work with fossils or stratigraphy in Tarrant County.

Doering, J. A., 1956, Review of Quaternary Surface Formations of the Gulf Coast Region, American Association of Petroleum Geologists Bulletin , Vol. 40, pp. 1816-1862, illus., maps.

Abstract: Classification of the Gulf Coast Quaternary, based on correlations with southwest Louisiana and the Atlantic Coastal Plain; an important reference.

Dooley, D., 1960, The Geology of Onion Creek Quadrangle, Ellis County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, iv + 17 pp., 8 text-figs., geol. map.

Abstract: Discussion of the Austin Formation, Taylor Marl, and Quaternary terraces.

Dumble, E. T., 1920, The Geology of East Texas, University of Texas Bulletin No. 1869, 388 pp., 12 pls., map.

Abstract: A classic work covering nearly the same area as the Trinity River drainage. Extended discussions of geologic history, structural geology, faunas and economic resources of the area.

Numerous measured sections and fossil localities. This reference must be consulted prior to any new geological undertakings in the area.

Dunkle, D. H., 1939, A New Paleoniscid Fish from the Texas Permian, American Journal of Science, Vol. 237, No. 4, pp. 262-274, 1 pl., 5 figs.

Abstract: Description of a new fish species and discussion of its phylogenetic position.

Localities:

(114) Arroyo Formation, Clear Fork Group of the Lower Permian on Indian Creek, Baylor County (type locality).

(115) Coffey Creek, Baylor County; locality of referred specimen.

Ellisor, A. C., 1933, Jackson Group of Formations in Texas with Notes on Frio and Vicksburg, American Association of Petroleum Geologists Bulletin , Vol. 17, pp. 1293-1350, illus.

Abstract: Basically stratigraphic in content; many measured sections with precise locality data; counties within the basin with measured sections: Polk, Trinity; this reference is a must for geological work in these two counties; Eocene.

Estes, R. D., 1969, Studies on Fossil Phyllodont Fishes: Casierius, a New Genus of Albulid from the Cretaceous of North America, Eclogae Geologiae Helvetiae, Vol. 62, Part 2, pp. 751-755, 2 pls.

Abstract: Description of a new genus of Cretaceous fishes with a shell-crushing type of dentition.

Localities:
(116) Greenwood Canyon, off Braden Branch of Denton Creek, 2.5 miles southwest of Forestburg, Montague County.

Fisher, W. L., P. V. Rodda and J. W. Dietrich, 1964, Evolution of Athleta petrosa Stock (Eocene, Gastropoda) of Texas, University of Texas Bulletin No. 6413, 117 pp., illus., maps.

Abstract: Comprehensive study of the evolution of an Eocene group of snails; many new species and type localities.

Localities:
(117) Houston County, Hurricane Bayou, bed of creek 0.2 to 0.5 mile upstream from bridge on Crockett-Rusk County road, 3.5 miles northeast of Crockett.
(118) Houston County, Alabama Ferry, east bank of Trinity River, 0.3 mile below abandoned ferry, 7.5 miles west-southwest of Porter Springs.
(119) Houston County, in gully on west slope of Cooks Mountain, 3 miles northwest of Crockett, just north of Farm Road 229.
(120) Houston County, Wheeler Springs School, waterfall on intermittent left tributary of Little Elkhart Creek, at wagon road, 0.4 mile airline distance southwest of Wheeler Springs School.
(121) Houston County, bluff on east bank of Trinity River at sharp bend, 0.9 mile airline distance north of Alabama Ferry.
(122) Houston County, Rock Flat west of Percilla, rock flat over which a tributary to Murchison Creek flows southward, 0.1 mile north of Farm Road 228 and 0.7 mile airline distance west of Percilla postoffice.
(123) Trinity County, White Rock Creek about 50 yards below the end of a dirt road leading west from secondary road (east of state highway 45) at old abandoned church, 8.0 miles north of Trinity.

(124) Leon County, 17 localities listed; should be consulted by anyone doing work in the county in stratigraphy, paleontology or salvage geology.

Gardner, J. A., 1925, A New Midway Brachiopod, Butler Salt Dome, Texas, American Journal of Science, Vol. 210, pp. 134-138, 1 pl .

Abstract: Description of a new species of Eocene brachiopod (a bivalve invertebrate similar in appearance to a clam); one of few good specimens in the area; type locality.

Localities:
(125) Freestone County, Butler Dome, 1/4 mile northwest of Gin Lake, 2 1/2 miles east of Butler.

Gardner, J. A., 1927, New Species of Mollusks from the Eocene of Texas, Washington Academy of Sciences Journal, Vol. 17, No. 14, pp. 362-383, 4 pls.

Abstract: Descriptions of 21 new species of Eocene pelecypods (clams) in Texas; type localities.

Localities:
(126) Leon County, 8 miles south of Jewett.
(127) Anderson County, 3/4 mile south of Elkhart.
(128) Houston County, Augusta.

Gardner, J., 1933, The Midway Group of Texas, University of Texas Bulletin No. 3301, 403 pp.

Abstract: Stratigraphic study of the Eocene/Paleocene sediments in Texas. Correlations largely biostratigraphic; the best and most comprehensive treatment of these rocks available. Numerous type localities in Kaufman, Henderson, Navarro, Freestone, Anderson, Limestone Counties.

Gardner, J. A., 1939, Notes on Fossils from the Eocene of the Gulf Province; 1, The Annelid Genus Tubulostium; 2, The Gastropod Families Cassididae, Ficidae, and Buccinidae, United States Geological Survey Professional Paper 193b, pp. ii + 17-44, 3 pls., 6 figs. including index maps.

Abstract: Part 1: Clarification of the descriptions and taxonomy of a genus of worms poorly known in the Tertiary Gulf sediments; 3 new species; one locality noted in Trinity basin: (Tubulostium leptostoma) is common from Wheelock and found in Caldwell County, noted from a previous, less precise description of a type locality.

Part 2: Clarification and descriptions of three families of late Mesozoic-early Tertiary snails; discussion of zoogeography and time distribution; one form particularly important for stratigraphy; 8 new species; no type localities in basin.

Gardner, J. A. and E. O. Bowles, 1939, The Venericardia planicosta Group in the Gulf Province, United States Geological Survey Professional Paper 189f, pp. ii + 143-215, 21 pls. including index and geological maps.

Abstract: Important study of a group of stratigraphically limited but cosmopolitan group of Eocene foraminifera; distribution, stratigraphy, descriptions of 44 species, including 24 new species; type localities in basin.

Localities:
(129) Houston County, Alabama Crossing on Trinity River, bed No. 1.
(130) Kaufman County, Water Hill 5 miles northeast of Kemp.
(131) Kaufman County, 2 1/2 miles northeast of Kemp on public road.
(132) Limestone County, Commanche Crossing 6 miles west of Mexia.
(133) Limestone County, 7 1/2 miles northwest of Groesbeck on the Thelma Road.
(134) Limestone County, 3 miles southwest of Thornton.
(135) Anderson County, Colgins Hill, 1 mile south of Palestine.
(136) Anderson County, road cut in Boston Road, 1 1/2 miles southeast of Palestine.
(137) Anderson County, 3/4 mile southeast of Palestine.
(138) Houston County, Percilla.
(139) Leon County, 1/2 mile east of Robins on the Centerville Road.

Godfrey, C. B., 1957, The Geology of the Seagoville Quadrangle, Dallas and Kaufman Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 27 pp., 2 text-figs., geol. map.

Abstract: Discussion of the Taylor Marl and Quaternary terraces.

Gordon, C. H., 1911, The Wichita Formation of Northern Texas, Journal of Geology, Vol. 19, pp. 110-134, map, illus.

Abstract: General early description of the Texas red-beds area on the edge of the Trinity River basin drainage; includes a chart listing fossils and collecting localities, some barely into the northern extent of the basin; an important early stratigraphic contribution.

Localities:
(140) Many localities; some in Archer, Young, Clay, Jack, and Montague Counties.

Hall, G. W. B. Jr., 1953, Geology of the Preston Hollow Quadrangle, Dallas, Collin, and Denton Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 13 pp., 1 text-fig.

Abstract: Discussion of the Eagle Ford and Austin Formations and Quaternary terraces.

Harlton, B. H., 1928, Pennsylvanian Foraminifera of Oklahoma and Texas, Journal of Paleontology, Vol. 1, No. 4, pp. 305-310, 2 pls.

Abstract: Description 15 new species.

Localities:
(141) At cut in Rock Island Railroad at Perrin road crossing, 3 miles southeast of Jacksboro, Jack County (only locality in basin).

Harrington, J. W., 1953, A Fossil Pleistocene Snake from Denton County, Texas, Field and Laboratory, Vol. 21, p. 20.

Abstract: Snake genus Drymarchon.

Localities:
(142) A borrow pit just north of Garza-Little Elm dam... across the Elm Fork of the Trinity River, Denton County.

Harris, G. D., 1896, The Midway Stage, Bulletins American Paleontology, Vol. 1, No. 4, 157 pp., illus.

Abstract: Description of the geology and paleontology of the Eocene sediments of the Midway Stage, now considered Paleocene; paleontology deals with mollusks exclusively; several new species; type localities.

Localities:
(143) Kaufman County, 4 miles northeast of Kemp.
(144) Kaufman County, public road crossing at Rocky Cedar Creek.
(145) Freestone County, Horn Hill, Tehuacana.

Harris, G. D., 1937, Turrid Illustrations; Mainly Clairbornian, Palaeontographica Americana, Vol. 2, No. 7, 122 pp., 14 pls.

Abstract: Comprehensive description and set of photographs for a common group of early Tertiary snails; localities in basin.

Localities:
(146) Houston County, Hurricane Bayou near Crockett.
(147) Houston County, Alabama Bluff, Trinity River.

Hawley, J. B. and J. P. Smith, 1933, Geologic Notes on the Lower Cretaceous of Eagle Mountain and Vicinity, Tarrant County, Texas, University of Texas Bulletin No. 3201, pp. 93-104, 1 pl.

Abstract: Stratigraphic and geologic history of a part of the Cretaceous of northwestern Tarrant County.

Localities:
(148) Around the margin of Lake Worth and in the Eagle Mountain Lake basin, Tarrant County.

Hay, O. P., 1924a, Description of Some Fossil Vertebrates from the Upper Miocene of Texas, Biological Society of Washington Proceedings, Vol. 37, pp. 1-19, 2 figs., 6 pls.

Abstract: Description of several new species of large Miocene vertebrates, all type localities outside of basin (mainly Grimes County); note on a collection from Cold Spring, San Jacinto County.

Hay, O. P., 1924b, The Pleistocene of the Middle Region of North America and Its Vertebrated Animals, Carnegie Institute of Washington Publication No. 322A, 385 pp., 5 figs., 29 maps.

Abstract: An exhaustive work giving a run-down of Pleistocene localities for each of 19 categories of large vertebrates, with discussion and analysis; a starting point for all work in Pleistocene vertebrate paleontology. Analysis of the Pleistocene in the Trinity River Valley; analysis of distribution maps for 29 categories of large Pleistocene vertebrates; localities for each animal.

Localities:

(149) Mastodon, Cooke County, in surficial deposits at Gainesville.

(150) Mastodon, Dallas County, in city limits of Dallas; Lagow gravel pit; gravel pit south of Dallas; near Wilmer under a bridge over a stream.

(151) Mastodon, Tarrant County, vicinity of Fort Worth, north side of Trinity River north of Fort Worth, a junction of Trinity River and Little Fossil Creek, 5 miles east of Fort Worth.

(152) Mastodon, Trinity County, near Clapps Ferry, 10 miles west of Trinity.

(153) Mastodon, San Jacinto County, one mile below Drews' Landing on the west bank of the Trinity.

(154) Elephas columbi, Collin County Panther Creek, 2 miles south of Rock Hill; gravel pit near McKinney.

(155) Elephas columbi, Tarrant County, no definite locale.

(156) _Elephas columbi_, Dallas County, various uncertain localities, and 5 miles south of Dallas along the Missouri, Kansas and Texas Railroad.
(157) _Elephas columbi_, Ellis County, no definite locale.
(158) _Elephas columbi_, Navarro County, near Corsicana.
(159) _Elephas columbi_, Trinity County near Trinity.
(160) _Elephas columbi_, Polk County, in a gravel pit.
(161) _Elephas imperator_, Tarrant County, near Fort Worth, in gravel pit 1.5 miles southwest of Fort Worth.
(162) _Elephas imperator_, Dallas County, in Dallas, in a gravel pit along Trinity River 4.5 miles east of Dallas; various along Trinity River.
(163) _Elephas imperator_, Ellis County, in the bed of a stream near Waxahachie.
(164) _Elephas imperator_, Polk County, in a gravel pit near Onalaska.
(165) Elephant, species indeterminant, Denton County, 5 miles from Denton.
(166) Elephant, species indeterminant, Collin County, in a gravel pit near McKinney.
(167) Elephant, species indeterminant, within city limits of Dallas.
(168) Elephant, species indeterminant, Navarro County, somewhere near Dawson.
(169) Elephant, species indeterminant, San Jacinto County, a mile below Drews' Landing on Trinity River.
(170) _Equus_, Denton County, 6 miles northeast of Denton.
(171) _Equus_, Dallas County, newly opened Lagow Pit one mile north of the old pit and in city limits.
(172) _Equus_, Anderson County, from Palestine.
(173) _Equus_, Trinity County, White Rock Shoals at the mouth of White Rock Creek.
(174) Camel, Dallas County, in Lagow Pit in Dallas.
(175) Deer, Dallas County, Lagow Pit.
(176) Extinct bison, Dallas County, Lagow Pit in Dallas, in the Vilbig sand pit east of Dallas near Rock Creek.

Heaslip, W. G., 1968, Cenozoic Evolution of the Alticostate Venericorids in Gulf and East Coastal North America, Palaeontographica Americana, Vol. 6, No. 34, pp. 52-135, 28 figs., 29 pls.

Abstract: A monumental study outlining the Tertiary evolution of an extremely important (stratigraphically) and common group of clams; 6 new species.

Localities:
(177) Houston County, 0.85 mile above Alabama Ferry on the Trinity River.
(178) Kaufman County, undefined locality.

Herrin, E. T., 1953, Correlation by Spectrographic Analysis of Bentonite in the Gulf Series of Dallas Area, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 27 pp., 2 text-figs., map.

Hill, R. T., 1887a, The Topography and Geology of the Cross Timbers and Surrounding Regions in Northern Texas, American Journal of Science, Vol. 33, pp. 291-303.

Hill, R. T., 1887b, The Texas Section of the American Cretaceous, American Journal of Science, Vol. 34, pp. 287-309.

Hill, R. T., 1889a, Checklist of the Invertebrate Fossils from the Cretaceous Formation of Texas, Accompanied by Notes on Their Geographic and Geologic Distribution, University of Texas, School of Geology, 16 pp., 3 pls.

Hill, R. T., 1889b, A Preliminary Annotated Checklist of the Cretaceous Invertebrate Fossils of Texas, Accompanied by a Short Description of the Lithology and Stratigraphy of the System, Geological Survey of Texas, Bulletin No. 4, 57 pp.

Hill, R. T., 1923, Further Contributions to the Knowledge of the Cretaceous of Texas and Northern Mexico (abs.), Geological Society of America Bulletins, Vol. 34, No. 1, pp. 72-73.

Abstract: Actually three abstracts, all relating to newly discovered stratigraphic details in the Texas Cretaceous.

Localities:
(179) On the north outer bluff of Denton Creek Valley in southern Denton County.
(180) Two miles west of Lone Oak, Hunt County.

Hoffmeister, J. E., 1929, A New Fossil Coral from the Cretaceous of Texas, U. S. National Museum Proceedings, Vol. 76, Art. 23, No. 2820, 3 pp., 2 pls.

Abstract: Description of new species.

Localities:
(181) From a thin bed in the Wolfe City sand of the Taylor Marl about one mile north 30° west of Farmersville, Collin County (type locality).

Holman, J. A., 1965, A Small Pleistocene Herpetofauna from Houston, Texas, Texas Journal of Science, Vol. 17, pp. 418-423.

Abstract: Description and analysis of the amphibians and reptiles recovered with the Sims Bayou local fauna (Slaughter and McClure, 1965).

Localities:
(182) Harris County, Sims Bayou.

Holman, J. A., 1966, A Small Miocene Herpetofauna from Texas, Quarterly Journal of the Florida Academy of Sciences, Vol. 29, No. 4, pp. 267-275, 1 text-fig.

Localities:
(183) Seven miles northeast of the town of Coldspring on the western bank of the Trinity River, San Jacinto County.

Ingles, J. J. C., 1957, The Geology of the Lancaster Quadrangle of Dallas and Ellis Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 17 pp., 5 text-figs., 2 pls. including geological map.

Abstract: Includes a table listing 14 localities, and a claim in the text for seven measured sections, but these are neither located nor discussed.

Jacobsen, J. M., 1961, Vertical Distribution of Foraminifera in the Lower Chalk Member of the Austin Formation, Southern Dallas County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, viii + 41 pp., 1 table, 1 text-fig., 1 pl.

Kellough, G. R., 1959, Biostratigraphic and Paleoecologic Study of Midway Foraminifera Along Tehuacana Creek, Limestone County, Texas, Gulf Coast Association of Geological Societies Transactions, Vol. 9, pp. 147-160, illus.

Abstract: Interpretation of the depositional environment of the Midway Shale (Eocene-Paleocene) based on a large foraminifer population recovered from Tehuacana Creek; also includes a list of other invertebrates associated with the fauna.

Localities:
(184) Limestone County, 4.5 miles north of Mexia where Tehuacana Creek crosses highway 14; section sampled from this creek bed and in bore holes from elsewhere.

Laramore, B. H., 1958, Geology of the Saginaw Quadrangle, Tarrant County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 33 pp., 2 tables, 7 text-figs., geological map.

Abstract: Stratigraphy and geologic history of Upper Cretaceous sediments; several measured sections, each with a faunal list; pelecypods, cephalopods, brachiopods, echinoderms.

Localities:
(185) On Marine Creek, immediately southwest of the Trinity Portland Cement Company and Meacham Field, Tarrant County.
(186) In Big Fossil Creek...for several hundred feet on either side of the bridge on the Saginaw-Watagua Road, Tarrant County.
(187) 3000 feet southeast of the Big Fossil Creek bridge on the Saginaw-Watagua road, Tarrant County.

(188) 3.3 miles southeast of Haslet, Tarrant County.

Laughbaum, L. R., 1959, A Paleoecologic Study of the Upper Denton Formation, Tarrant, Denton, and Cooke Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 68 pp., 3 text-figs.

Abstract: An extended paleoecology study with environmental interpretations based on the invertebrate faunas; several measured sections.

Localities:
(189) In a bluff over Sycamore Creek in Cobb Park, on Cobb Park Drive, 1/2 mile south of the Maddox Street bridge, Fort Worth, Tarrant County.
(190) In a ravine east of Denton Creek about 2 miles east of Justin, Denton County; this in the type locality of the Denton Formation.
(191) In a bluff over Big Fossil Creek, about 0.3 mile west of U.S. highway 377, 40 yards west of railroad bridge crossing creek, Tarrant County.
(192) In a bluff over a small creek approximately 2 miles east of Sanger, Denton County.
(193) In a roadcut of an unmarked road northeast of Sanger about 3.6 miles north of Farm Road 455, Denton County.
(194) In a roadside ditch near Hockley Creek, 3.5 miles northeast of Valley View, Cooke County.
(195) In a ravine 1/2 mile south of pump station on Red River and 1/2 mile east of U.S. highway 77, Cooke County.

Loeblich, A. R. Jr. and H. N. Tappan, 1941, Some Palmate Lagenidae from the Lower Cretaceous Washita Group, Bulletins of American Paleontology, Vol. 26, No. 99, illus.

Abstract: Descriptions of 12 new species of large common foraminifera.

Localities:
(196) In a roadcut on the east side of the road, just inside the entrance to Forest Park, 0.4 mile due

north of the northeast corner of the campus of Texas Christian University, Fort Worth, Tarrant County.

(197) In roadcuts for about 1/4 mile, on the road leading eastward to Grayson Bluff from the Fort Worth-Denton highway, about 1 mile east of the highway, 3 1/2 miles northeast of Roanoke, Denton County.

(198) In a deep roadcut on the Denton-Aubrey road about 0.1 mile south of the bridge over Clear Creek, 4.8 miles by road northeast of the Denton County Courthouse square, in Denton, Denton County.

(199) In a low north-facing cliff, forming the south bank of Hickory Creek, 150 feet north of the road leading northwest from Krum to Trinity Farms, 8 miles northwest from Krum, Denton County.

(200) In the roadcut and on the side of the hill along the west side of the Fort Worth-Burleson highway, where it swings southward near the top of the hill, 1/4 mile southeast of where the Fort Worth-Everman road turns from the Fort Worth-Burleson highway, southeast of Fort Worth, Tarrant County.

(201) On the south bank of a small gully flowing northward to empty into a tributary of Sycamore Creek which was dammed to form Katy Lake, 1/4 east of and below the Katy Lake Dam, southeast of Fort Worth, Tarrant County.

(202) In a low, east-facing creek bank, west of the Joshua-Cleburne road at the northern edge of the town of Cleburne, Johnson County.

(203) In roadcuts on the western edge of the Federal Narcotic Farm, southeast of Fort Worth, Tarrant County.

Loeblich, A. R. Jr. and H. N. Tappan, 1946, New Washita Foraminifera, Journal of Paleontology, Vol. 20, No. 3, pp. 238-258, illus.

Abstract: Descriptions of 29 new species of Lower Cretaceous foraminifera from southern Oklahoma and northern Texas; includes 4 new genera; an important stratigraphic contribution.

Localities:

(204) Grayson formation at Grayson Bluff, a high southwest-facing bluff on Denton Creek, 3 1/2

miles northeast of Roanoke, 2 miles by road east of the Fort Worth-Denton highway, Denton County.
(205) Denton Formation 1/2 mile east of the underpass under the Frisco Railroad, in the banks of a small stream, 1.9 miles from where the "Frisco road" branches from the Old Cleburne road and crosses the Frisco tracks, 0.3 mile south of Berry Street in Fort Worth, Tarrant County.
(206) On the hillside on the west side of the Fort Worth-Burleson Highway, where the highway swings southward near the top of the hill, 1/4 mile southeast of where the Fort Worth-Everman road turns from the Fort Worth Burleson highway, southeast of Fort Worth, Tarrant County.
(207) Katy Lake locality, Tarrant County.
(208) Federal Narcotic Farm locality, Tarrant County.
(209) Denton Formation in the Gainesville Brick Pit, an unworked pit southeast of Gainesville, Cooke County.

Loeblich, A. R. Jr. and H. N. Tappan, 1949, Foraminiferal Fauna from the Walnut Formation (Lower Cretaceous) of Northern Texas and Southern Oklahoma, Journal of Paleontology, Vol. 23, No. 3, pp. 245-266, illus.

Abstract: Foraminiferal fauna of the Walnut Clay (Fredericksburg group), with 47 species, 13 new.

Localities:
(210) In a large square pit, excavated at the site of the Denison Dam, north of Denison, Grayson County.

Lozo, F. E. Jr., 1944, Biostratigraphic Relations of Some North Texas Trinity and Fredericksburg (Comanchean) Foraminifera, American Midland Naturalist, Vol. 31, No. 3, pp. 513-582, illus., index maps.

Localities:
(211) Numerous localities in Grayson, Denton, Wise, Parker and Tarrant Counties.

Lull, R. S., 1921, Fauna of the Dallas Sand Pits, American Journal of Science, Vol. 202, pp. 159-176, 5 figs.

Abstract: The first extensive faunal paper on Trinity River terraces, based on Shuler's collections, mainly from the Lagow Pit, mostly large mammals.

Localities:
(212) Sand pits around Dallas, especially Lagow Sand Pit, Dallas County.

Lundelius, E., 1949, Note on a Neural Spine of a Permian Armored Amphibian (abs.), Geological Society of America Bulletins, Vol. 60, No. 12, Part 2, p. 1906.

Abstract: Short note on evolutionary relationships of several Permian amphibians. Fragments collected from Rattlesnake Canyon, Archer County.

MacNeil, F. S., 1935, Fresh-water Mollusks from the Catahoula Sandstone (Miocene) of Texas, Journal of Paleontology, Vol. 9, No. 1, pp. 10-17, 3 pls.

Abstract: Description of two new genera and five new species of clams, freshwater Miocene, important intermediate forms between Cretaceous and recent known specimens.

Localities:
(213) 5 miles north of LaGrange (Fayette County), about 1/2 mile northwest of the south corner of the James Green League. Found in the upper part of a quartzitic sandstone, etc. (U.S. Geological Survey Station No. 12676).

McJunkin, H. H. Jr., 1955, The Stratigraphy of the Grayson Formation in Tarrant County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, 40 pp., 8 text-figs., 3 pls., geological map.

Localities:
(214) Grayson Bluff, 3.7 miles north 51° east of Roanoke, Denton County.

(215) A northwestward facing slope two miles north of Handley, Tarrant County.

(216) On a south facing slope 200 yards north of U.S. highway 80, on the Wadell Ranch, 1.5 miles east of Handley, Tarrant County.

(217) On a southwestward facing hill about 1 mile east of Burleson, Johnson County.

McNulty, C. L., 1963, Teeth of Petalodus alleghaniensis Leidy from the Pennsylvanian of North Texas, Texas Journal of Science, Vol. 15, pp. 351-353, illus.

Abstract: Note of the first formal recognition of these late Paleozoic shark teeth in the Texas area, with descriptions.

Localities:

(218) In the quarry of the Wesco Corporation, 4 1/2 miles northwest of the town of Bridgeport, Jack County (Wise ? County) Texas.

McNulty, C. L., 1964, Hypolophid Teeth from the Woodbine Formation, Tarrant County, Texas, Eclogae Geologiae Helvetiae, Vol. 57, Part 2, pp. 537-539, 1 pl.

Abstract: Descriptions of several rare fossil ray teeth of Late Cretaceous age.

Localities:

(219) In low cuts along road to Central Airlines Operations Hangar, Southwest International Airport, Tarrant County.

McNulty, C. L. and G. Kienzlen, 1970, An Enchodontid Mandible from the Eagle Ford Shale (Turonian), Dallas County, Texas, Texas Journal of Science, Vol. 21, pp. 447-451, illus.

Abstract: Discussion based on the recovery of a large Cretaceous fish, with comments regarding osteology, distribution and functional anatomy.

Localities:

(220) On the south bank of the Trinity River, at a point about 100 yards east of the Loop 12 bridge in west-central Dallas County.

McNulty, C. L. and B. H. Slaughter, 1962a, A New Sawfish from the Woodbine Formation (Cretaceous) of Texas, Copeia 1962, pp. 775-777, illus.

Abstract: New species of fossil sawfish.

Localities:
(221) Lewisville and Euless members of the Woodbine Formation on the west and south margins of Carter Field, Tarrant County, Texas.

McNulty, C. L. and B. H. Slaughter, 1962b, An Ichthyosaurian Centrum from the Albian of Texas, Journal of Paleontology, Vol. 36, pp. 346-347, illus.

Abstract: Report on the recovery of a vertebral element for these rare (in Texas) marine reptiles of the Cretaceous.

Localities:
(222) A sewer excavation along Long Street in the proximity of Marine Creek in the Rosen Heights section of Fort Worth, Texas, dug between 1926 and 1929, Tarrant County.

McNulty, C. L. and B. H. Slaughter, 1964, Rostral Teeth of Ischyrhiza mira Leidy from Northeast Texas, Texas Journal of Science, Vol. 16, pp. 107-112, illus.

Abstract: Description of teeth from extinct fossil sawfish in Cretaceous sediments, with a discussion on evolutionary relationships.

Localities:
(223) Hebron, Texas, in southernmost Denton County; in south-facing bank of a cut for the Gulf, Colorado, and Santa Fe Railroad; along the west side of the Hebron Baptist Church.
(224) Midlothian, Texas; northwestern Ellis County; in deep cut on north side of Highway 287 on western side of town at point about .75 mile west of intersection of highway 287 and highway 67.
(225) Terrell, Texas; 4 1/2 miles (airline) north on the land of Matthew C. Roberts and across FM 1392

from the abandoned Bachelor schoolhouse; in uppermost portion of several gullies which drain northwest into Little High Point Creek, north-central Kaufman County.

Meier, R. W., 1964, Geology of the Britton Quadrangle, Dallas, Ellis, Johnson, and Tarrant Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, viii + 24 pp., 3 text-figs., geological map.

Abstract: Includes several detailed measured sections.

Localities:
(226) 3.0 miles due west of Cedar Hill, 0.3 mile east of the quadrangle's limits, just north of Mansfield Road, Dallas County.
(227) 3.4 miles due west of Cedar Hill along Bagget Branch, 0.4 mile north of Mansfield Road, Dallas County.
(228) 4.3 miles south 80° west of Cedar Hill, 1/2 mile west of Anderson Road, just north of Mansfield Road, Dallas County.
(229) 0.9 mile south of Mansfield Road, just west of Boss Cope Road, Dallas County.
(230) 2.3 miles north of Britton, just east of Sutton Road along an unnamed tributary of Mountain Creek, Tarrant County.
(231) 0.9 mile south of Webb along Bowman Ranch on the Webb-Mansfield road, Tarrant County.
(232) Along an unnamed tributary of Walnut Creek, 1.9 miles north 30° east of Mansfield, Tarrant County.

Meyer, W. G., 1939, Stratigraphy and Historical Geology of Gulf Coastal Plain in Vicinity of Harris County, Texas, American Association of Petroleum Geologists Bulletins, Vol. 23, No. 2, pp. 145-211, 8 figs., including index and paleogeography maps.

Abstract: Comprehensive study of the sediments of late Tertiary age in the vicinity of Harris County, with extended discussion of paleogeography. No measured sections.

Michael, Fouad Yousry, 1971, Studies of Foraminifera from the Comanchean Series (Cretaceous) of Texas, Ph.D. thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, vii + 87 pp., 7 text-figs., 7 pls.

Abstract: Regional stratigraphic study with paleo-environmental interpretations based on foraminifera; 21 localities in basin in Denton, Tarrant, Cooke, Parker, Grayson, Johnson, Coryell, and McLennan Counties.

Moreman, W. L., 1942, Paleontology of the Eagle Ford of North and Central Texas, Journal of Paleontology, Vol. 16, No. 2, pp. 192-220, illus.

Abstract: Paleontological distribution and paleogeography of the common ammonites, clams, and oysters of the Eagle Ford Shale in north central Texas; mainly biostratigraphic.

Localities:
(233) 2.25 miles east of Tarrant, Texas, railway station (measured along railroad tracks) just north of the railroad trestle on a small tributary of the Trinity River, Tarrant County.
(234) 4 miles south of Alvarado, Texas on the east side of the Waco highway, Johnson County.
(235) 4 miles east of Whitesboro, Texas, 0.25 mile south of the Whitesboro-Sherman highway, Grayson County.
(236) 0.5 mile east of the Britton-Midlothian highway 2.7 miles south of the Britton, Texas railway station in small ravines cut in the westward facing slope, Ellis (?) County.
(237) 4 miles south of the Britton, Texas railway station on the Midlothian highway in a ravine east of the road, Ellis (?) County.
(238) 100 yards east of the bridge on the Britton-Midlothian highway at a point 4.4 miles south of the Britton railway station, Ellis (?) County.
(239) In a small ravine just south of the Lewisville-Hebron road 3.5 miles east of the Lewisville railroad station, Denton County.

(240) In bluffs on Indian Creek 5.5 miles east of the Lewisville railway station on the Hebron road; one bluff is near the road on the south side, the other is 0.5 mile south of the road, Denton County.

(241) In a small ravine 100 yards north of the Prosper-Denton road 3 miles west of Prosper, Texas, Denton County.

(242) 6 miles northwest of the central business block of Irving, Texas, or 3.2 miles north of Sowers, Texas, where a tributary of Hackberry Creek forms a low bluff on the east side of the road, Dallas County.

(243) 4.35 miles north of Sowers, Texas. where the Sowers-Coppell road turns right (east) one mile, and 0.5 mile north of the road on a tributary of Hackberry Creek, Dallas County.

(244) 3.4 miles southeast of Pottsboro, Texas on the Whitesboro road, Grayson County.

(245) 1.4 mile east of Carrollton, Texas in an exposure on the north side of the road on Rawhide Creek, Dallas County.

(246) In a tributary of Hackberry Creek about 0.25 mile west of the Hackberry-Irving road, 1 mile south of the intersection west of the Dallas-Rhome highway, Dallas County.

(247) On the south bank of the Elm Fork of the Trinity River at a point where the railroad north out of Irving, Texas crosses the river, Dallas County.

(248) One mile south of Arcadia Park, Texas, Tarrant County.

(249) Two miles west of Arcadia Park, Texas, Tarrant County.

Overmyer, D. O., 1953, Geology of the Pleasant Grove Area, Dallas County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, iii + 11 pp., 3 text-figs., geological map.

Palmer, K. V. W., 1937, The Claibornian Scaphopoda, Gastropoda, and dibranchiate Cephalopoda of the Southern United States, Bulletins of American Paleontology, Vol. 7, No. 32, in 2 parts, 730 pp., 91 pls.

Abstract: A major work on the molluscan fauna of the Eocene; an extremely important contribution to paleontology and stratigraphy, many new genera and species; type locality.

Localities:
(250) Leon County, about 1 mile southeast of Robbins.

Patillo, L. G., 1940, River Terraces in the Carrollton Area, Dallas County, Texas, Field and Laboratory, Vol. 8, No. 1, pp. 27-37.

Abstract: Description of Pleistocene river terraces along Trinity River (Elm Fork) and its tributaries.

Patterson, B., 1941, Early Cretaceous Mammals from Northern Texas, American Journal of Science, Vol. 249, pp. 31-46, illus.

Abstract: The first record of mammals in the lower Cretaceous of Texas; an important and later, far-reaching paper, having an ultimate important bearing on the understanding of early mammalian evolution. Descriptions of several new species.

Localities:
(251) Approximately 2 1/2 miles southwest of Forestburg, Montague County.

Patterson, B., 1955, A Symmetrodont from the Early Cretaceous of Northern Texas, Field Museum of Natural History Zoology Series, Vol. 37, pp. 689-693, 1 fig.

Abstract: Descriptions of the first known recovery of a jaw and teeth from an extinct group of Cretaceous mammals. New genus and species. An important paper.

Localities:
(252) Greenwood Canyon exposures, 2 1/2 miles southwest of Forestburg, Montague County.

Patterson, B., 1956, Early Cretaceous Mammals and the Evolution of Mammalian Molar Teeth, Fieldiana, Geology, Vol. 13, pp. 1-105, illus.

Abstract: A major work in vertebrate paleontology, describing the mammalian fauna of Early Cretaceous age from Texas with many new genera and species; and a synthetic analysis of the evolutionary trends of changes in dentition in early mammals.

Localities:
(253) Greenwood Canyon, 2 1/2 miles southwest of Forestburg, Montague County.

Peabody, W. W., 1957, The Geology of the Waxahachie Quadrangle, Ellis County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ii + 17 pp., 5 text-figs., geological map.

Peck, R. E., 1943, Lower Cretaceous Crinoids from Texas, Journal of Paleontology, Vol. 17, No. 5, pp. 451-475, illus.

Abstract: Discussion of several families of lower Cretaceous crinoids, with new genera and species. Many localities, too numerous to list in this report: Denton, Grayson, Johnson, Tarrant, and Cooke Counties.

Perkins, B. F. and C. C. Albritton, 1955, The Washita Group in the Valley of the Trinity River, Texas, A Field Guide, Fondren Science Series, No. 5, 27 pp., pls., 1 map.

Abstract: Field guide for seven exceptionally good exposures of Washita Group (Upper Cretaceous) sediments. All localities fossil bearing.

Localities:
(254) Grayson Bluff, Denton Creek, Denton County.
(255) Roadcut west of Grayson Bluff, Denton Creek, Denton County.
(256) Southeast edge Fort Worth city limits, Tarrant County, Seminary Drive and Sycamore Creek.
(257) Southeast edge of Fort Worth city limits, Cobb Park, Tarrant County.
(258) Approximately 2 miles south of Fort Worth at Sycamore Creek and Crowley Road (FR 731) Tarrant County.

(259) Santa Fe railroad cuts, 8 miles southwest of Fort Worth, Tarrant County.
(260) Feltz Ranch Quarry on Rocky Creek approximately 6 miles southwest of Fort Worth, Tarrant County.

Pessagno, E. A., Jr., 1967, Upper Cretaceous Planktonic Foraminifera from the Western Gulf Coastal Plain, Palaeontographica Americana, Vol. 5, No. 37, pp. 245-445, 63 figs., 101 pls.

Abstract: Extensive monograph.

Localities:
(261) Scony Mobil Oil Co., Field Research Laboratory, Dallas Core of type Eagle Ford, 5.2 miles south of the old Eagle Ford station on the Texas Pacific Railroad; 3.5 miles south of Arcadia Park, 10 miles north northwest of Britton and 12.5 miles southeast of the old Tarrant Station on the St. Louis, San Francisco and Texas Railroad (Dallas County).
(262) Clay pit of Baron Brick Co. at Palmer, Ellis County.

Pitkin, J. A., 1959, The Geology of the Palmer Quadrangle, Ellis County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ii + 25 pp., 7 text-figs., geological map.

Plummer, H. J., 1926, Foraminifera of the Midway Formation in Texas, University of Texas Bulletin No. 2644, 206 pp., 15 pls., including map.

Abstract: Detailed account of the early Tertiary foraminifera of Texas; many new genera and species from a total of 41 type localities, including the following counties in the basin: Hunt, Van Zandt, Kaufman, Henderson, Navarro, Freestone, Anderson, Limestone Counties; this important reference should be consulted by any future workers planning to collect invertebrate fossils in the area.

Plummer, H. J., 1934, Epistominoides and Coleites, New Genera of Foraminifera, American Midland Naturalist, Vol. 15, No. 5, pp. 601-608, 1 pl.

Abstract: Descriptions of two new Eocene genera and several new species for each; one locality in the basin.

Localities:
(263) Limestone County, steep bank along the east side of the tributary flowing due north into Tehuacana Creek, about 2 miles in a direct line north and slightly west of the center of the town of Mexia, about 1/4 mile west of the railroad.

Plummer, H. J., 1936, Structure of *Ceratobulimina*, American Midland Naturalist, Vol. 17, No. 2, pp. 460-463, 10 figs.

Abstract: Description of the internal structure of the tests of this common foraminifer genus in Eocene sediments in central Texas.

Localities:
(264) Limestone County, in east bank of a small tributary to Tehuacana Creek, 2 miles north and a little east of Mexia.
(265) Leon County, from an exposure in a road ditch, 0.15 mile northeast of the steel bridge over Boggy Creek and 0.7 mile south of the Middleton post office.

Poag, C. W., 1962, *Dicrorygma*, A New Ostracod Genus from the Lower Cretaceous of Texas, Journal of Paleontology, Vol. 36, pp. 827-829, illus.

Abstract: Description of new genus and species of this bivalved type of arthropod.

Localities:
(266) "an exposure of the Kiamichi Formation on the west side of the railroad, 2 miles south of the Texas and Pacific Railroad shops and 150 feet east of the "Stove Foundry Road" at Fort Worth, Tarrant County.

Quinn, J. H., 1952, Recognition of Hipparions and Other Horses in the Middle Miocene Mammalian Faunas of the Texas Gulf Region, Texas University Bureau of Economic Geology Report of Investigations 14, pp. 5-6.

Abstract: Discussion of the evolution and ancestry of mid-Tertiary horses; abundant fossil remains from the Texas Tertiary, but no precise locality information (horse teeth, because of their durability, are among the most common Miocene vertebrate fossils recovered in Texas).

Quinn, J. H., 1955, Miocene Equidae of the Texas Gulf Coastal Plain, University of Texas Bulletin No. 5516, 102 pp., illus.

Abstract: Systematic description of Miocene horses of Texas; evolution and distribution, extended discussion of Miocene faunas in North America including correlation and relationships; general locality map showing distribution of 29 Miocene Texas localities; precise locality data housed with Texas Bureau of Economic Geology, University of Texas.

Localities:
(267) Polk County, Burkeville faunal zone near Moscow.
(268) San Jacinto County, Point Blank.
(269) San Jacinto County, on the Mrs. Lila Bennet farm, 3.5 miles west and 2 miles south of Point Blank.

Quinn, J. H., 1957, Pleistocene Equidae of Texas, University of Texas Bureau of Economic Geology Report Investigations 33, 51 pp., illus.

Abstract: Systematic study of Pleistocene horses of Texas; evolution, descriptions of species, and taxonomy; localities in basin.

Localities:
(270) A Trinity River terrace.
(271) Ingleside Pit
(272) Henderson County, Boatwright gravel pit, 2.5 miles northwest of Trinidad (addition to faunal list of the site originally described by Stovall

and McAnulty, 1950, of Onager (ass) and Homo femur and stone images as listed by Sellards, 1944 and 1952).

Rathbun, M. J., 1935, Fossil Crustacea of the Atlantic and Gulf Coastal Plain, Geological Society of America Special Paper 2, 160 pp., 2 figs., 26 pls.

Abstract: Detailed, valuable work on fossil crustaceans; many collecting localities; type localities in Tarrant, Grayson, Cooke, Collin, Navarro, Leon Counties -- too numerous to enumerate, but should be consulted by any geologist working in the area.

Reaser, D. F., 1957, The Geology of the Ferris Quadrangle, Dallas and Ellis Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, iv + 22 pp., 7 text-figs., geological map.

Reed, L. C., 1957, Geology of the Midlothian Quadrangle, Ellis County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ii + 26 pp., 12 text-figs., geological map.

Renick, B. C., 1937, The Jackson Group and the Catahoula and Oakville Formation in a Part of the Texas Gulf Coastal Plain, University of Texas Bulletin No. 3619, 104 pp., illus., map.

Abstract: Barely out of the Trinity River drainage; an important report; numerous vertebrate and invertebrate fossils from surface exposures in these early Tertiary outcrops to the west of Walker and Madison Counties.

Richards, H. G., 1939, Marine Pleistocene of Texas, Geological Society of America Bulletin, Vol. 50, No. 12, Part 1, pp. 1885-1898, 3 pls., including index map.

Abstract: Study of Texas Gulf Coast Pleistocene sediments, with numerous fossil localities.

Localities:

(273) Harris County: "some land shells were obtained between the depths of 46 and 77 feet from a water well...about 5 miles south and slightly west of Houston".

(274) Hardin County: two wells.

(275) Chambers County: "an exposure of shells along the shore of Galveston Bay at Houston Point about 7 miles southeast of Goose Creek.

(276) Chambers County: "a shell locality...at the headwaters of Trinity Bay on Oyster Creek."

(277) Galveston County: shells from dredgings and wells.

Roberts, C. N., 1953, Geology of the Dallas Quadrangle, Field and Laboratory, Vol. 21, pp. 21-33, 4 text-figs., (Dallas County).

Rodda, P. U. and W. L. Fisher, 1962, Upper Paleozoic Acrothoracic Barnacles from Texas, Texas Journal of Science, Vol. 14, pp. 460-479, illus.

Abstract: Discussion of burrowing barnacles in Paleozoic invertebrates which possessed some sort of hard skeleton.

Localities:

(278) Wise County: (a) west side of Hunt Creek, Waggoner Ranch, near Bridgeport (b) west side of Martins Lake, 1.6 miles south of Bridgeport (c) Bridgeport clay pit (d) east side of Hunt Creek south of old Jacksboro Road (e) Landers Ranch, Bridgeport.

(279) Young County: (a) 3 miles southwest of Newcastle (b) 4 miles northeast of Newcastle.

Romer, A. S., 1928, Vertebrate Faunal Horizons in the Texas Permo-Carboniferous Red Beds, University of Texas Bulletin No. 2801, pp. 67-108, 1 fig.

Abstract: A summary of the stratigraphic horizons which are particularly productive for vertebrate fossils by an authority in the area. Localities not well described or located, as characteristic of the time and workers of the region; some of the area discussed includes Archer County.

Romer, A. S., 1935, Early History of Texas Red Beds Vertebrates, Geological Society of American Bulletin , Vol. 46, No. 11, pp. 1597-1658, 5 text-figs., index map.

Abstract: A major work on some of the earliest known terrestrial vertebrates and associated fauna; an extremely important area to vertebrate paleontology.

Localities:
(280) Numerous localities in Archer, Young, Clay, Jack and Montague Counties.

Romer, A. S., 1957, The Appendicular Skeleton of the Permian Embolomerous Amphibian _Archeria_, Michigan University Museum of Paleontology Contributions, Vol. 13, No. 5, pp. 103-159, illus.

Abstract: Morphological description of these important but extinct amphibians, known from only a couple localities elsewhere in the world.

Localities:
(281) All barely out of Trinity drainage, in Archer and Young counties.

Romer, A. S. and L. I. Price, 1939, The Oldest Vertebrate Egg, American Journal of Science, Vol. 237, No. 11, pp. 826-829, 1 pl.

Abstract: Description of the oldest known vertebrate (reptilian) egg from the Permo-Carboniferous red beds of Texas.

Localities:
(282) Rattlesnake Canyon, southeast of Black Flat in the northwestern part of Archer County, Texas.

Romer, A. S. and R. V. Witter, 1942, _Edops_, A Primitive Rhachitomous Amphibian from the Texas Red Beds, Journal of Geology, Vol. 50, No. 8, pp. 925-960, illus.

Abstract: Description of the skull and post-cranial skeleton for this primitive Permo-Carboniferous amphibian. Localities in Archer, Jack, and Young Counties, not accurately located.

Sale, C. M., 1957, Geology Along the Clear Fork of the Trinity River Southwest of Fort Worth, Texas, including Benbrook Lake, thesis, Graduate School, Texas Christian University, Fort Worth, Texas, vii + 96 pp., 50 pls.

Abstract: Geologic history, stratigraphy, structure and economic geology.

Localities:
(283) Includes many measured sections, Tarrant County.

Scott, G., 1928, Ammonites of the Genus Dipoloceras and a new Hamites from the Texas Cretaceous, Journal of Paleontology, Vol. 2, No. 2, pp. 108-118, 1 fig., 2 pls.

Abstract: Descriptions of 5 new species of ammonites from the north Texas Fredericksburg.

Localities:
(284) At the Goodland locality, one mile northwest of Benbrook, Tarrant County.
(285) At a locality 20 miles northwest of Fort Worth, and about 2 miles north of a point where the White Settlement road crosses the Tarrant-Parker County line, Tarrant County.
(286) Under a small bridge where the Pecan Beach road crosses Chara Creek, one mile northwest of Texas Christian University, Tarrant County.
(287) Two miles northwest of Texas Christian University at the nine mile dam on the Clear Fork of the Trinity River, Tarrant County.

Scott, G., 1940, Cephalopods from the Cretaceous Trinity Group of the South-Central United States, Texas University Publication No. 3945, pp. 969-1106, illus., index maps.

Abstract: Descriptions of ammonites and relatives from Lower Cretaceous sediments; important stratigraphic and paleontologic content.

Localities:
(288) In the bed of Ash Creek under the concrete bridge of the Jacksboro highway 1/4 mile southeast of Azle, Tarrant County.

Scott, G. and J. M. Armstrong, 1932, The Geology of Wise County, Texas, University of Texas Bulletin No. 3224, 77 pp., 7 figs., 2 pls.

Abstract: General account. Several localities with fossils.

Sellards, E. H., 1940a, Stone Images from Henderson County, Texas (abs.), Geological Society of America Bulletin , Vol. 51, No. 12, Part 2, pp. 1944.

Abstract of this abstract: Report of three stone images found in a gravel pit in Henderson County; discussion of terraces and included fauna; found that the implements came from the highest of 3 terraces of Pleistocene age.

Sellards, E. H., 1940b, New Fossil Localities in Texas (abs.), Geological Society of America Bulletin , Vol. 51, No. 12, Part 2, pp. 1977-1978.

Abstract of this abstract: Report on paleontological excavation progress in Texas, including several areas in the basin.

Localities:
(289) Polk County, Miocene vertebrates.
(290) Fannin and Grayson Counties, Upper Cretaceous vertebrates and invertebrates.

Sellards, E. H., 1940c, Early Man in America; Index to Localities and Selected Bibliography, Geological Society of America Bulletin , Vol. 51, No. 3, pp. 373-431, illus.

Abstract: Comprehensive list of North American early man localities, covering the period 1839-1939.

Localities:
(291) Lagow sandpit locality Lagow sandpit, Dallas, discovered 1920, Dallas County.

Sellards, E. H., 1941, Stone Images from Henderson County, Texas, American Antiquity, Vol. 7, No. 1, pp. 29-38, illus., map.

Abstract: These crude heads represent one of the unsolved mysteries of Texas archaeology; for associated fauna and stratigraphy, see Stovall and McAnulty, 1950.

Sellards, E. H., W. S. Adkins and F. B. Plummer, 1932, The Geology of Texas, Vol. 1, Stratigraphy, University of Texas Bulletin No. 3232, 1007 pp., 54 figs., 11 pls. including geological map.

Abstract: A vast and useful work; should be consulted by any paleontologist/geologist before making surveys in the area; bibliography and index useful and well organized; numerous localities and stratigraphic sections.

Shaw, N. G., 1956, Geology of the Benbrook Quadrangle, Tarrant County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, vi + 38 pp., 11 text-figs., 2 tables, geological map.

Localities:
(292) Along the Clear Fork of the Trinity on the Granbury highway, U.S. 377, Tarrant County.
(293) Other measured sections in the quadrangle, located on the geologic map by index number, Tarrant County.

Sholl, V. H., 1956, The Stratigraphy of the Templeton Member of the Upper Cretaceous Woodbine Formation in Eastern Denton County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, iii + 27 pp., geological map, cross-section.

Abstract: Includes ten measured sections.

Shuler, E. W., 1918, The Geology of Dallas County, University of Texas Bulletin No. 1818, 54 pp., 21 pls. including map.

Abstract: An early description of the geography, topography, general geology, geologic history, economic resources and altitudes in Dallas County;

written in a popular style "so that it may reach the largest audience possible". Includes many stratigraphic sections; necessary reading for anyone working in the area.

Shuler, E. W., 1923, Occurrence of Human Remains with Pleistocene Fossils, Lagow Sand Pit, Dallas, Texas, Science, Vol. 57, pp. 333-334.

Abstract: Association of human remains with a distinct Sangamon vertebrate fauna. Puzzling, unsolved problem. Shuler was convinced that the association was real, not a mixed occurrence.

Localities:
(294) Lagow Sand Pit, Dallas County.

Shuler, E. W., 1934, Collecting Fossil Elephants at Dallas, Texas, Field and Laboratory, Vol. 3, No. 1, pp. 24-29, 3 figs.

Abstract: General description of elephant remains in the Dallas area Trinity River terraces, and a short discussion of early man in North America; Dallas County.

Shuler, E. W., 1935, Terraces of the Trinity River, Dallas County, Texas, Field and Laboratory, Vol. 3, No. 2, pp. 44-53, 2 figs., maps.

Abstract: The first systematic description of Trinity River terraces, delimiting 4 levels: Union Terminal, Travis School, Love Field and Irving Terraces; Dallas County. Interpretations altered later by radiocarbon dating and more extensive analysis.

Shuler, E. W., 1950, A New Elasmosaur from the Eagle Ford Shale of Texas-the Elasmosaur and Its Environment, Fondren Science Series, No. 1, Part 2, 32 pp., illus.

Abstract: Description of a remarkably complete elasmosaur skeleton from Upper Cretaceous sediments. Technical description plus a popular account.

Localities:
(295) On the Andy Anderson plantation, west of Cedar Hill, Dallas County.

Slaughter, B. H., 1959, The First Noted Occurrence of *Dasypus bellus* in Texas, Field and Laboratory, Vol. 27, No. 2, pp. 77-80, illus.

Abstract: First Texas report of these Sangamon-age armadillos. Several other localities now known to include *D. bellus* also.

Localities:
(296) Hickory Creek, near its junction with the Trinity River in southern Denton County.

Slaughter, B. H., 1965a, A Therian from the Lower Cretaceous (Albian) of Texas, Yale University Peabody Museum of Natural History Postilla, Vol. 93, pp. 1-18, illus.

Abstract: Description of a phylogenetically important intermediate family of early modern-type mammals based on teeth recovered from Wise County.

Localities:
(297) In a shallow gully 250 yards northeast of U. S. highway 81, 3 miles northwest of Decatur, Wise County, on the farm of Mr. Lee Butler.

Slaughter, B. H., 1965b, Preliminary Report on the Paleontology of the Livingston Reservoir Basin, Texas, Fondren Science Series No. 10, 12 pp., 1 map.

Abstract: Appraisal of paleontological resources of the Lake Livingstone (then) proposed area to be flooded; extensive mapping and prospecting produced abundant Miocene and Quaternary vertebrate fossils; 22 localities shown on map, now all inundated; several of the localities collected prior to flooding.

Slaughter, B. H., 1966, The Moore Pit Local Fauna; Pleistocene of Texas, Journal of Paleontology, Vol. 40, pp. 78-91, illus.

Abstract: Description of several new species, and a faunal list for this Pleistocene vertebrate fauna, with discussion of climate and environment.

Localities:
(298) Moore Pit locality, within the southern city limits of Dallas, Texas, about 100 yards to the rear of the Morton House Furniture Company at 6606 Carter Road, Dallas County.

Slaughter, B. H., 1968a, Earliest Known Marsupials, Science, Vol. 162, pp. 254-255, 1 fig.

Abstract: Report and description of the earliest known marsupial-type mammals in the world from Lower Cretaceous sediments, at the Butler Farm locality, north of Decatur, Texas. Important bearing on early evolution of mammals; Wise County.

Slaughter, B. H., 1968b, Earliest Known Eutherian Mammals and the Evolution of Premolar Occlusion, Texas Journal of Science, Vol. 20, pp. 3-12, illus.

Abstract: A classic study of the remains of the earliest known modern-type placental mammals. Descriptions of the fossils, all teeth, and a synthetic analysis of the early changes in dental characteristics leading to modern and Tertiary mammals.

Localities:
(299) Butler Farm locality, Wise County.

Slaughter, B. H. and W. I. McClure, 1965, The Sims Bayou Local Fauna: Pleistocene of Houston, Texas, Texas Journal of Science, Vol. 17, pp. 404-417, illus.

Abstract: Description and climatic implications of a moderately large vertebrate fauna of Sangamon Interglacial or Early Wisconsin (Late Pleistocene) age. An interesting place to find a bone deposit; discovered as a result of Flood Control Engineer straightening of Sims Bayou in Houston in 1958, with fossils uncovered during excavations.

Localities:
(300) Sims Bayou is a tributary of Buffalo Bayou which in turn feeds into the San Jacinto River just eight miles above its mouth at Galveston Bay, Harris County.

Slaughter, B. H. and R. Ritchie, 1963, Pleistocene Mammals of the Clear Creek Local Fauna, Denton County, Texas, Journal of the Graduate Research Center, Southern Methodist University, Vol. 31, pp. 117-131, illus., map.

Abstract: Description of the mammalian representatives of a second-terrace Sangamon (Late Pleistocene) Interglacial fauna, with discussion of stratigraphy and ecological inferences.

Localities:
(301) Trietsch Pit, an abandoned gravel pit along Clear Creek north of Denton, Denton County; and Oapitz pit one mile downstream from Trietsch Pit.

Slaughter, B. H. and J. T. Thurmond, 1965a, Geological and Paleontological Survey of the Bardwell Reservoir Basin, Ellis County, Texas, Fondren Science Series, No. 8, pp. 1-10, 1 map.

Abstract: Description of a small Cretaceous marine fauna; stratigraphy and paleontology of Pleistocene terraces.

Localities:
(302) A pit just south of state highway 34, east of Bardwell, Ellis County.
(303) Big Mustang Creek, 1500 feet south of U.S. 287, Ellis County.
(304) From east side of the outlet works excavation, Bardwell Dam, Ellis County.

Slaughter, B. H. and J. T. Thurmond, 1965b, Geological and Paleontological Survey of the Forney Reservoir Basin, Kaufman and Rockwall Counties, Texas, Fondren Science Series No. 7, pp. 1-11, 1 map.

Abstract: Description of small Cretaceous marine fauna. Stratigraphy and paleontology of the Quaternary terraces, description of a small fauna from the basin.

Localities:
(305) West bank of Taylor Creek, 100 yards west of Farm Road 1140, 1 mile south of Heath, Rockwall County.

Springer, V. G., 1957, A New Genus and Species of Elopid Fish (Laminospondylus transversus) from the Upper Cretaceous of Texas, Copeia, No. 2, pp. 135-140, illus.

Abstract: Description of a new species of Cretaceous fish, based on fourteen specimens from two localities.

Localities:
(306) "Fannin County, Savoy Pit, University of Texas Loc. No. 31051, site no. 1: 4 miles south on surfaced road from Savoy, east on dirt road for 0.75 mile. Quarry is on west slope of hill just beyond the first creek south of the road." Then description of the horizons collected.
(307) Grayson County, Wallace Quarry, Site No. 3: "H. G. Wallace farm, 6.5 miles northwest of Sherman, in the base of the Austin chalk." Note: There are also pencil maps accompanying the field catalogues in the files of the Vertebrate Paleontology Laboratory, University of Texas.

Stenzel, H. B., 1934, Decapod Crustaceans from the Middle Eocene of Texas, Journal of Paleontology, Vol. 8, No. 1, pp. 38-56.

Abstract: Discussion of fossil crustaceans from several Eocene localities, only one in basin.

Localities:
(308) Houston County, the bluff on Hurricane or Threemile Bayou, 0.3 mile above the bridge over this creek, 3.35 miles northeast of the Houston County Courthouse on the Crockett-Rusk road.

(309) Leon County, seven localities which were not particularly fossil-rich but were important to the fauna.

Stenzel, H. B., 1935a, Middle Eocene and Oligocene Decapod Crustaceans from Texas, Louisiana, and Mississippi, American Midland Naturalist, Vol. 16, No. 3, pp. 379-400, 3 pls., 1 fig.

Abstract: Discussion of the early Tertiary decapod crustaceans in south-central U.S.; valuable contribution to stratigraphy and paleontology; descriptions of 8 new species; type localities.

Localities:
(310) Houston County, at the base of the bluff on the right bank of Hurricane or Threemile Bayou 0.3 mile above the bridge over the bayou, which is 3.5 miles north-northeast of the Houston County Courthouse on the Crockett-Rusk road (includes measured section).
(311) Leon County, 5.75 miles east of Marquez; and many other localities in Leon County which are not type localities.

Stenzel, H. B., 1935b, Nautiloids of the Genus Aturia from the Eocene of Texas and Alabama, Journal of Paleontology, Vol. 9, No. 7, pp. 551-562, 2 pls., 6 figs.

Abstract: Descriptions of two subgenera and several new species of Eocene nautiloids; type localities.

Localities:
(312) Leon County, Bold Mound in the H. R. Benson 70 acres, Robert Wood Survey, 4.3 miles northwest of Centerville.
(313) Leon County, north ditch of Robbins-Centerville Road, 0.6 mile southeast of Robbins.

Stenzel, H. B., 1939, The Geology of Leon County, Texas, University of Texas Bulletin No. 3818, pp. 1-295, 1 pl., 61 figs., geological map.

Abstract: Detailed stratigraphy, physiography, structure and economic geology of the county; includes a list of type localities for fossils for Leon and part of the adjacent Madison County, and should be consulted by any investigator of invertebrate paleontology in the county; too many localities (approximately 60) to list in this report.

Stenzel, H. B. 1940a, Tertiary Nautiloids from the Gulf Coastal Plain, University of Texas Bulletin No. 3945, pp. 731-794, illus.

Abstract: Extended description of these common Texas fossils; type localities.

Localities:
(314) Leon County, small draw tributary to a branch which flows northward along the east line of P. L. Reinhardt 200-acre tract and enters Boggy Creek; the small draw is north of a wagon road of N. 68° E direction and in the northeast part of the tract, about 3.5 miles airline distance east of Leona.
(315) Houston County, Kickapoo Shoals, flat bench in bed of Trinity River at sharp bend 1.72 miles upstream from toll bridge as measured along the course of the stream.
(316) Navarro County, south side of Foggyhead Creek in Smith's pasture and about 0.15 mile west of the bridge on Kerens-Round Prairie road, 3.8 miles by road south-southeast of the depot in Kerens.

Stenzel, H. B., 1940b, The Yegua Problem, University of Texas Bulletin No. 3945, pp. 847-910, illus., index map.

Abstract: Extended discussion of a perplexing stratigraphic problem: where to draw a precise boundary for the top of the Yegua; several important measured sections in Madison and Leon Counties in basin.

Stenzel, H. B., 1940c, New Zone in Cook Mountain Formation, the _Crassatella texalta_ Harris--_Turitella cortezi_

Bowles Zone, American Association of Petroleum Geologists Bulletin , Vol. 24, No. 9, pp. 1663-1675, illus., index map.

Abstract: Description of an important fossil zone in this Eocene formation, allowing correlation with corresponding sedimentary rocks in the Rio Grande embayment and in Louisiana; three important measured sections, with fauna.

Localities:

(317) Leon County, Two-mile Creek; exposures along creek banks beginning at iron bridge at Leona--Two-mile School country road 4 miles southeast of Leona, airline distance, and extending up creek to sharp meander in creek about 1/2 mile from iron bridge.

(318) Houston County, Alabama Ferry, left bank of Trinity River about 0.2-0.5 mile downstream from the abandoned Alabama Ferry, about 7.5 miles west-southwest of Peter Springs; exposures on left bank of river, beginning 600 feet below the ferry and extending 2000 feet downstream.

(319) Houston County, Hurricane Bayou, bed of creek 0.2-0.5 mile up creek from bridge on Crockett-Rusk county road, 3.35 miles northeast of Crockett.

Stenzel, H.B., 1944, A New Paleocene Catemotope Crab from Texas, Tehuacana tehuacana, Journal of Paleontology, Vol. 18, No. 6, pp. 546-549, illus.

Abstract: Description of a new species of square-footed crab, Paleocene age; type locality.

Localities:

(320) Limestone County, Tehuacana Creek, about 1 mile southwest of the crossing of the Houston and Texas Central Railroad, about 3 1/2 to 4 miles south of Wortham.

Stenzel, H. B., 1945, Decapod Crustaceans from the Cretaceous of Texas, University of Texas Bulletin No. 4401, pp. 401-476, illus.

Abstract: Comprehensive work with important bearings on stratigraphy and anatomy. Descriptions of new species.

Localities:
(321) California Crossing, north-facing bluff on right bank of Elm Fork of Trinity River upstream from and at Chicago, Rock Island & Pacific Railroad bridge, about 10 miles northwest of Dallas, Dallas County.
(322) About 3 miles southwest of Farmersville, Collin County.
(323) Rock pit on south side of an east-west road, by road 4.66 miles southeast of Savoy, Fannin County.
(324) A small waterfall at crossing of Houston and Texas Central and International and Great Northern Railroad tracks in Sycamore Creek Valley, 2 1/2 miles south-southeast of Fort Worth, Tarrant County.
(325) Near Crowley, Tarrant County.
(326) Brickyard pits, 1 3/4 miles southeast of Gainesville, Cooke County.
(327) Gullies in pasture about 0.1 mile east and within site of U.S. highway No. 377 (Fort Worth-Denton Road), and 0.2 mile north of Watauga schoolhouse, northern Tarrant County.
(328) Above a muddy tank to the left of the Frisco Railroad tracks, 1 mile northeast of Denison, Grayson County.

Stenzel, H. B. and F. E. Turner, 1940a, Turritellidae from the Paleocene and Eocene of the Gulf Coast, University of Texas Bulletin No. 3945, pp. 829-846, illus.

Abstract: Description of a stratigraphically important group of early Tertiary snails.

Localities:
(329) North ditch of Concord-Centerville county road 0.6 mile southeast of Robbins crossroads, in south corner of J.M. Powell 100-acre tract, Leon County.

(330) Quarry and creek approximately 1 mile south of Ola, eastern Kaufman County.

Stenzel, H. B. and F. E. Turner, 1940b, The Gastropod Genera Cryptochorda and Lapparia in the Eocene of the Gulf Coastal Plain, University of Texas Bulletin No. 3945, pp. 795-828, illus.

Abstract: Description of these two genera of early Tertiary snails; discussion of stratigraphic importance; several new species described; type localities.

Localities:
(331) Leon County, gully 0.15 mile north of Concord-Centerville county road, 2.11 miles east of Robbins cross-roads, right tributary of McDaniel Creek, 0.1 mile east of a fence and 0.15 mile west of east line of J. E. Morris 89-acre tract.
(332) Houston County, (undescribed locality).

Stephenson, L. W., 1936, New Upper Cretaceous Ostreidae from the Gulf Region, U. S. Geological Survey Professional Paper 186-A, pp. ii + 1-12, 4 pls.

Abstract: Description of 3 new species of Cretaceous oysters.

Localities:
(333) Cut in Gaston Avenue (U.S. Hwy 67), just north-east of the intersection of West Shore Drive, 0.7 mile west of the dam of White Rock Reservoir, Dallas County.
(334) Other collecting sites in Ellis, Dallas, Fannin Counties.

Stephenson, L. W., 1937a, Stratigraphic Relations of the Austin, Taylor and Equivalent Formations in Texas, U. S. Geological Survey Professional Paper 186-G, pp. ii + 133-146, 1 pl., geological map, 1 fig.

Abstract: Biostratigraphic correlation based on faunal zones in upper Austin-age (Late Cretaceous) and the lower Taylor-age sediments, with summary of the geological history; many measured sections with fauna.

Localities:
(335) Many outcrop localities in Dallas County.
(336) Many outcrop localities in Grayson County.
(337) Outcrop exposures in Collin County.
(338) Outcrop exposures in Fannin County.
(339) Outcrop exposures in Ellis County.
(340) Measured sections: 0.7 mile northwest of Whitewright, Grayson County.

Stephenson, L. W., 1937b, Linter, A New Taxodont Genus from the Upper Cretaceous of Texas, Washington Academy of Sciences Journal, Vol. 27, No. 11, pp. 449-451, 5 figs.

Abstract: Descriptions of one new genus and two new species of peculiar clam-like mollusks; type localities.

Localities:
(341) Navarro County, public road south of the St. Louis Southwestern (Cotton Belt) Railroad, about 5 miles south-southwest of Corsicana.
(342) Navarro County, a small branch west of the Corsicana-Chatfield road, at the north end of the M. R. and M. J. Thompson property, 2 miles north of Corsicana.
(343) Navarro County, borrow pit just east of U.S. highway 75, at foot of north-facing slope of Chambers Creek Valley, 4 miles north of the Corsicana Courthouse.

Stephenson, L. W., 1941, The Large Invertebrate Fossils of the Navarro Group of Texas (exclusive of corals and crustaceans and exclusive of the fauna of the Escondido Formation), University of Texas Bulletin No. 4101, 641 pp., illus., index map.

Abstract: An extremely thorough study with literally hundreds of localities shown on index maps and discussed in text; far too many localities to abstract in this comprehensive classical work; localities concentrated in Kaufman, Hunt, Collin, Navarro and Limestone Counties.

Stephenson, L. W., 1944, Fossils from Limestone of Buda Age in Denton County, Texas, American Association of Petroleum Geologists Bulletin , Vol. 28, No. 10, pp. 1538-1541.

Abstract: Stratigraphic emphasis. Fossils and measured section for these Late Cretaceous-age sediments.

Localities:
(344) In north-south road on south facing slope of Denton Creek Valley, 4.8 miles east by north of Roanoke, Denton County.

Strimple, H. T. and W. T. Watkins, 1964, Carboniferous Crinoids of Texas with Stratigraphic Implications, Palaeontographica Americana, Vol. 6, No. 40, pp. 137-275, 56 pls.

Abstract: Monumental work on the crinoids of Texas Pennsylvanian sediments, and a stratigraphic analysis.

Localities:
(345) On a roadcut 4 miles west of the railroad station at Bridgeport, Wise County, and 0.01 mile north on the paved road off the Lake Bridgeport road.
(346) About 3/4 mile southwest of Lake Bridgeport Dam, Wise County, Texas.
(347) At road corner close to the site of Old Consolation School (no longer standing), 3 miles in direct line southwest of Brock, Parker County.

Taff, J. A., 1893, Report on the Cretaceous Area North of the Colorado River, Texas Geological Survey Annual Report No. 4, Part 1, pp. 241-354.

Abstract: An early detailed survey of the Cretaceous stratigraphy in north central Texas.

Localities:
(348) Numerous sections in Dallas, Tarrant, Denton, Grayson Counties and other areas; although outdated, a good general description of the Cretaceous sediments of the area.

Tappan, H. N., 1940, Foraminifera from the Grayson Formation of Northern Texas, Journal of Paleontology, Vol. 14, No. 2, pp. 93-126, illus.

Abstract: Fauna including 90 species of foraminifera, one new genus, 32 new species.

Localities:
(349) Grayson Bluff, a high, southwest-facing bluff on Denton Creek, 3 1/2 miles northeast of Roanoke, 2 miles by road east of the Fort Worth-Denton highway, Denton County.

Tappan, H. N., 1941, New Arenaceous Foraminifera from the Woodbine Sand of Northern Texas, Journal of Paleontology, Vol. 15, No. 4, pp. 359-361, illus.

Abstract: Description of 3 new species.

Localities:
(350) From the basal Woodbine clay, below sandy strata, in a roadside ditch on the west side of the road in the 800 block, south Lamar Street, just north of East Munson Avenue, in the southeast part of the city of Denison, Grayson County.

Stephenson, L. W., 1946, Fulpia, A New Upper Cretaceous Bivalve Mollusk from Texas and Maryland, Journal of Paleontology, Vol. 20, No. 1, pp. 68-71, illus.

Abstract: Description of a new species of clam.

Localities:
(351) Sheep Creek, 3 1/2 miles northwest of Fulp, Fannin County; other localities in Tarrant, Denton, Grayson, Fannin Counties but not located.

Stephenson, L. W., 1952, Larger Invertebrate Fossils of the Woodbine Formation (Cenomanian) of Texas, U.S. Geological Survey Professional Paper 242, IV, 226 pp., 59 pls., 1 table, index map.

Abstract: An excellent biostratigraphic study with detailed descriptions of the fossils and locality data.

Localities:
(352) 231 localities, most of them in the basin, and all well located; McLennan, Hill, Johnson, Tarrant, Denton, Cooke, Grayson, Fannin, Lamar, Red River Counties; this is probably the single most comprehensive listing of the Woodbine Formation collecting locations available.

Stovall, J. W., 1933, Xiphactinus audax, A Fish from the Cretaceous of Texas, University of Texas Bulletin No. 3201, pp. 87-92, 1 pl.

Abstract: Description of a remarkable large Cretaceous fish.

Localities:
(353) The farm of Roy Williams, 4 miles northeast Celina, Collin County.

Stovall, J. W. and W. N. McAnulty, 1950, The Vertebrate Fauna and Geologic Age of Trinity River Terraces in Henderson County, Texas, American Midland Naturalist, Vol. 44, pp. 211-250, illus.

Abstract: Correlation of Pleistocene stratigraphic units in Henderson and adjoining counties with equivalent formation of the Gulf Coastal Plain; determination of coastal terrace ages as compared with glacial deposits in glaciated states; recognized 3 distinct terraces with associated vertebrate fauna, all Wisconsin (Late Pleistocene glacial stage) age; areas of study within basin including Henderson, Freestone, and Navarro Counties.

Localities:
(354) Henderson County, the high terrace between the Trinity and Neches Rivers; produced most of the fossils in the study.
(355) Navarro County, terraces along state highway 19 on the Navarro side of the Trinity.
(356) Freestone County, fossils from the John W. Carpenter farm on a high terrace along the Trinity River, 1.5 miles west of the river and 100 yards south of state highway 22.

(357) Navarro County, other fossils from 23 miles northeast of Corsicana on Valley Farms in the northeastern part of the county.

Tappan, H. N., 1943, Foraminifera from the Duck Creek Formation of Oklahoma and Texas, Journal of Paleontology, Vol. 17, No. 5, pp. 476-517, illus.

Abstract: Description of 120 species of foraminifera, 37 new, from this Lower Cretaceous formation in the upper reaches of the basin. Locality description includes good measured sections.

Localities:
(358) In a road cut on the east side of the road, just inside the entrance to Forest Park, 0.4 mile due north of the northeast corner of the Texas Christian University campus in Fort Worth, Tarrant County.
(359) In a high east-facing bluff on the west bank of Ammonite Creek, about 500 feet south of the road marking the northern boundary of the municipal golf course, southwest of Fort Worth, Tarrant County.
(360) In a low, north-facing cliff on the south bank of a small stream, a short distance north of the road, 0.1 mile east of the bridge which crosses the creek, 0.9 mile east of Fink (locally called Georgetown), Grayson County.

Taylor, E. H. and C. J. Hesse, 1943, A New Salamander from the Upper Miocene Beds of San Jacinto County, Texas, American Journal of Science, Vol. 241, No. 3, pp. 185-193, illus.

Abstract: Description of a Miocene salamander skull (a rare find); new genus and species; type locality.

Localities:
(361) San Jacinto County, 3 miles west of Coldspring.

Thurmond, J. T., 1967, Quaternary Deposits of the East Fork of the Trinity River, North-Central Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas xi + 74 pp., 3 text-figs., 2 pls., 4 tables, cross-section, 2 geological maps.

Abstract: Detailed study including extensive faunal analysis: snails, clams, fish, reptiles and mammals; paleoecological conclusions and climatic inferences.

Localities:
(362) Includes drainage areas in Kaufman, Dallas, Rockwall, Collin, Grayson, Fannin Counties.

Thurmond, J. T., 1969a, Lower Vertebrates and Paleoecology of the Trinity Group (Lower Cretaceous) in North-Central Texas, Ph.D. thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ix + 128 pp., 32 text-figs.

Abstract: An extensive examination of paleoecology with systematic descriptions of fishes and sharks, including 9 new taxa.

Localities:
(363) 33 localities with faunal list for each; Cooke, Montague, Wise, Tarrant, Parker Counties in basin.

Thurmond, J. T., 1969b, Notes on Mosasaurs from Texas, Texas Journal of Science, Vol. 21, pp. 69-80, 2 figs.

Localities:
(364) Dallas County, White Rock Lake: Austin Chalk.
(365) Fannin County, North Sulfur River near Ladonia: Taylor.
(366) Collin County, near Farmersville: Taylor.
(367) Dallas County, University Park, Snider Plaza exc.: Austin.
(368) Ellis County, 1 mile northeast Bardwell, Taylor Marl.
(369) Ellis County, Cryer Creek, Taylor.
(370) Ellis County, Bardwell Dam outlet Cryer Creek, Austin.

(371) Dallas County, Hackberry Creek Eagle Ford Shale.
(372) Dallas County, 3 1/2 miles west of Cedar Hill.

Turner, W. L., 1950, Geology of the Eagle Ford Quadrangle, Dallas County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, iv + 29 pp., 7 text-figs., geological map.

Udden, J. A., C. L. Baker and C. Bose, 1916, Review of the Geology of Texas, University of Texas Bulletin No. 1644, pp. 1-164, illus., map.

Abstract: General treatment. Updated by Sellards, et al., 1933 (University of Texas Bulletin No. 3232).

Uyeno, T. and R. R. Miller, 1962, Late Pleistocene Fishes from a Trinity River Terrace, Texas, Copeia 1962, pp. 338-345, illus.

Abstract: Fish fauna comprised of 6 or 7 species of freshwater fishes, assigned to the Sangamon Interglacial (Late Pleistocene). Extension of the several vertebrate faunas by Slaughter and collaborators then recovered from Trinity River terraces; this was one of the first good fish faunas from the Pleistocene.

Localities:
(373) From the T-2 terrace of the Trinity River at the southern city limit of Dallas, Dallas County.

Vaughan, T. W. and W. P. Popenoe, 1935, The Coral Fauna of the Midway Eocene of Texas, in The Midway Group of Texas, by Julia Gardner, University of Texas Bulletin No. 3301, pp. 325-343, pls. 3 and 4 in part.

Abstract: Descriptions of Eocene corals in the Midway of Texas, now considered Paleocene; two localities in basin.

Localities:
(374) Navarro County, 3 1/2 miles to 4 miles south of Wortham.
(375) Limestone County, Tehuacana member of the Kincaid Formation.

Vieaux, D. G., 1941, New Foraminifera from the Denton Formation in Northern Texas, Journal of Paleontology, Vol. 15, No. 6, pp. 624-628, illus.

Abstract: Description of 10 new species.

Localities:
(376) "Locality A": Denton Formation at Flagpole Hill, 3 1/2 miles northeast Denison, on Riverside Park Road, Grayson County.
(377) "Locality B": Section of the Denton-Weno contact in the cut of the St. Louis and San Francisco railroad, just west of the Riverside Park Road, about 1 1/2 miles northeast of Denison, Grayson County, at the 633.1 mile post of the railroad.
(378) "Locality F": Denton Formation, in creek bank in Munson Park, west of U.S. highway 75 and just north of exit from park, one mile north of Denison, Grayson County.

Vormelker, R. S., 1962, Vertical Distribution of Foraminifera in the Upper Chalk Member of the Austin Formation, Northern Ellis County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, viii + 58 pp., 1 table, 2 pls.

Abstract: Includes several measured sections.

Wells, J. W., 1933, Corals of the Cretaceous of the Atlantic and Gulf Coastal Plains and the Western Interior of the United States, Bulletins of American Paleontology, Vol. 18, No. 67, 204 pp., 4 figs., 16 pls.

Abstract: Important descriptions of many fossil corals; type specimens from the following localities.

Localities:
(379) Duck Creek beds of the basal Washita Division at the type locality of the Duck Creek, northeast of Denison, Grayson County.
(380) Pawpaw beds of the middle Washita on Sycamore Creek, Fort Worth, Tarrant County.
(381) From the Weno beds of the Middle Washita Division below the Katy Lake dam, Fort Worth, Tarrant County.

(382) Grayson Marl at Grayson Bluff, Grayson County.
(383) In the "Goodland" Formation at Cragin's Knobs, 5 miles west Fort Worth, Tarrant County.
(384) Navarro Formation near Terrell, Kaufman County.
(385) Wolfe City sand member of the Taylor Formation about 1 mile north 30° west of Farmersville, Collin County.
(386) Navarro formation in a creek 1/4 mile north of Corsicana, Navarro County.

Welles, S. P., 1949, A New Elasmosaur from the Eagle Ford Shale of Texas; Systematic Description, Fondren Science Series, No. 1, Part 1, 28 pp., illus.

Abstract: Description of an early find of an extinct large marine reptile from the Cretaceous. New species.

Localities:
(387) Andy Anderson farm near Cedar Hill, Dallas County.

Welles, S. P. and B. H. Slaughter, 1963, The First Record of the Plesiosaurian Genus, Polyptychodon (Pliosauridae) from the New World, Journal of Paleontology, Vol. 37, No. 1, pp. 131-133, illus.

Abstract: Description of the remains of a short-necked plesiosaur, a marine reptile of the Cretaceous, new species.

Localities:
(388) 100 yards west of Chalk Hill Road and 300 yards north of West Commerce, Dallas, Dallas County.

White, M. P., 1933, Some Texas Fusilnidae, University of Texas Bulletin No. 3211, 106 pp., 10 pls.

Abstract: Descriptions of a variety of Texas foraminifera; many new species; type localities, several in Jack, Young, and Parker Counties barely into basin.

Williams, T. E., 1957a, Remains of a Pleistocene Turtle from a Terrace Deposit near Seagoville, Dallas County, Texas, Field and Laboratory, Vol. 25, p. 34.

Abstract: Short note on the recovery of a large turtle.

Localities:
(389) Smith Gravel Company pit, 3 miles southeast of Seagoville, immediately southeast of the Bois d'Arc Road, and 0.7 mile southwest of its intersection with Combine Road, Dallas County.

Williams, T. E., 1957b, Correlation by Insoluble Residues in the Austin Chalk of Southern Dallas County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ii + 15 pp., 1 pl., geological map.

Willimon, E. L., 1970, Quaternary Gastropods and Paleo-ecology of the Trinity River Floodplain of Dallas County, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, ix + 89 pp., 2 tables, 11 text-figs.

Wilson, J. A., 1954, Miocene Carnivores, Texas Coastal Plain (abs.), Geological Society of America Bulletins, Vol. 65, p. 1326.

Abstract: Report on several carnivores from the Texas Miocene having a bearing on biostratigraphic relation-ships in the Texas Miocene.

Winn, V., 1953, Geology of the Carrollton Quadrangle, Dallas and Denton Counties, Texas, thesis, Department of Geological Sciences, Southern Methodist University, Dallas, Texas, i + 15 pp., 2 text-figs.

Winton, W. M., 1925, The Geology of Denton County, University of Texas Bulletin No. 2544, pp. 1-86, 8 figs., 21 pls., map.

Abstract: Includes several stratigraphic measured sections with fossil content. These should be re-examined for their fossil content, and re-described.

Winton, W. M. and W. S. Adkins, 1920, The Geology of Tarrant County, University of Texas Bulletin No. 1931, pp. 1-123, 6 figs., 6 pls., 2 maps.

Abstract: Description of physiography, topography, fossils, geology and economic resources of Tarrant County.

Localities (measured sections with fauna):

(390) North end of Lake Worth dam, Tarrant County.

(391) Azle road 9 miles northwest of Fort Worth, Tarrant County.

(392) Stove Foundry road 1/2 way between Fort Worth and Benbrook, Tarrant County.

(393) Sections at Lake Worth, Mary's Creek north of Benbrook, Bear Creek southwest of Benbrook, Tarrant County.

(394) Azle road, 2 miles east of Azle, Tarrant County.

(395) Azle road, 6 miles northwest of Fort Worth, Tarrant County.

(396) Both sides of run southeast of first turn of street car track, 1/4 mile north of Texas Christian University and 3 1/2 miles southwest of Fort Worth, Tarrant County.

(397) Forest Park, near east entrance, Tarrant County.

(398) Eastward facing exposure in run 1/2 mile east of Texas Christian University, 3 miles southwest of Fort Worth, Tarrant County.

(399) First turn of car track 1/4 mile north of Texas Christian University and 3 1/2 miles southwest of Fort Worth, Tarrant County.

(400) Bluff 100 yards north of the Houston and Texas Central Railway Bridge across Sycamore Creek, 4 miles southeast of Fort Worth, Tarrant County.

(401) Sycamore Creek near the Houston and Texas Central Railway, 4 miles southeast of Fort Worth, Tarrant County.

(402) Keller Road, 1 mile south of Haslet, Texas, Tarrant County.

(403) 2 miles southeast of Burleson, Johnson County.

(404) Pit in Acme Brick Yards, Denton, Denton County.

Winton, W. M. and G. Scott, 1922, The Geology of Johnson County, University of Texas Bulletin No. 2229, pp. 1-68, 4 figs., 4 pls., map.

Abstract: Several stratigraphic sections included in this general treatment. These sections should be re-examined for their fossil content and re-described.

Young, K. P., 1958, Graysonites, A Cretaceous Ammonite in Texas, Journal of Paleontology, Vol. 32, No. 1, pp. 171-182, illus.

Abstract: Description of a new genus and species of a Texas Cretaceous ammonite.

Localities:
(405) Hill County, top of Mainstreet Limestone.
(406) Cooke County, Grayson Formation.

Zangerl, R. and R. H. Denison, 1950, Discovery of Early Cretaceous Mammals and Frogs in Texas, Science, Vol. 112, p. 61.

Abstract: Report of the first mammal discovered in the Early Cretaceous of the New World. Associated with turtles, crocodiles, dinosaurs, pterosaurs, frogs and fish.

Localities:
(407) "Early Cretaceous Trinity Sands of Montague County, Texas.

Summary and Recommendations

Potentially valuable productive areas are scattered over the entire basin. Particularly important are the Permian "red-beds" region; the Lower Cretaceous formations for early mammals; Upper Cretaceous for invertebrates and marine reptiles; Paleocene and Eocene sediments for possible early mammals and important invertebrates for intercontinental correlations; middle Tertiary formations for invertebrates and mammals; late Tertiary and Pleistocene sediments for invertebrates and important vertebrate localities. It is impossible to select any one area over another as being more important or potentially more productive. Because of the nature of the accidents of discovery of fossils, any outcrop is liable to provide important new material for study, for both the paleontologist and the stratigrapher. It must be emphasized that all outcrops are important, the new and the old alike. For this reason, no particular recommendations regarding specific localities are included in this report. Future investigators in particular regions must necessarily decide on the basis of the literature and on field surveys which measures are imperative in the face of possible destruction of outcrops.

Although it is not this writer's duty to predict what changes should ensue as a result of construction of reservoirs, certain effects will surely be realized:

1. Depending on relation to reservoir and dam, subsidiary drainages are likely to alter their present form; new exposures will appear in places, and old exposures will be covered to varying degrees.

2. Many of the important collecting sites will be flooded and forever lost to scientific interests.

3. Locality data, however imprecise, will be rendered even more useless to future generations as old roads and exposures are abandoned and/or flooded, and new cultural developments crowd around the reservoir.

4. Classical sites, even if not flooded, are likely to be destroyed by canalization and straightening of the course of the river or otherwise altered as construction and building of dams progresses.

It is with these ideas in mind that this writer has concluded that all sites within the basin are potentially likely to be destroyed or altered as the result of construction of reservoirs and canalization of the Trinity River. The following general recommendations should be seriously considered before any major undertaking in the area:

1. All important stratigraphic and paleontological sites in the drainage area to be affected should be revisited if locality data is precise enough to afford relocation, and the following procedures are imperative.

a. collection of as many fossils as possible from the locality, with precise locality data and pertinent references included in the collection at each site,

b. photographs made of the locality with adequate scale and exact position of sites penciled in, with labelled stratigraphic units,

c. accurate location of the site on a good sharp aerial photograph, from a source generally available to the public,

d. accurate measurement of any exposure where fossils are recovered, and any other exposure of possible importance in stratigraphy, with precise altitude information included,

e. distribution of fossils and information from each site as outlined in a-d to any institution wishing to receive a sample of the collection,

f. formation of a main repository for all fossils, locality data, and measured sections in a major institution with adequate facilities and personnel to guarantee accessibility and maintenance of the collection.

2. The entire area to be affected should be thoroughly surveyed by a competent field party to locate undescribed

exposures and to examine the outcrops for the fossil content and stratigraphic importance; collection of fossils and stratigraphic information should be conducted with all earnestness.

3. The results of salvage work in any way amplifying or changing the present state of knowledge regarding the paleontology and stratigraphy should be published in a suitable journal, with the notice that the area is to soon be affected by drainage changes, and that revisitation is encouraged for those interested in outcrops in the area.

4. A competent field party director should be encouraged to determine exact localities for which further measures should be considered:

a. Excavation with heavy equipment of productive sites for extending accessibility and collection of fossils.

b. Evaluation of the potential need for actually preserving entire sections of outcrops of stratigraphically important sequences. For example, the contact between Upper Cretaceous and Paleocene sediments is poorly known; excavation in a region where the contact will be exposed should result in total preservation and removal of a large block which includes the contact.

c. Excavations should be visited periodically by a competent paleontologist and examined carefully for fossil content; merely having construction workers watch for fossils has repeatedly proven to be totally unacceptable.

CHAPTER VII

AN ASSESSMENT OF SCIENTIFIC LITERATURE IN THE TRINITY RIVER BASIN

by

James V. Sciscenti
Assistant Professor
Department of Anthropology

AN ASSESSMENT OF SCIENTIFIC LITERATURE IN THE TRINITY RIVER BASIN

The passage of the National Environmental Policy Act (Public Law 91-190) represented a major reorientation in the methods of planning and the kinds of variables which must be included and properly assessed on governmental projects which alter the face of the landscape. In essence, the Act called for the use of a multi-disciplinary approach to decision making and a much closer working relationship between the scientific community and decision implementing bodies within the national sociocultural system.

Specific provisions of the Act call for the preparation of an environmental impact statement in each construction situation. The Impact Statement is essentially a summary evaluation, based on an inventory of the resources which exist within the construction areas; these resources include botanical and zoological species, habitat zones, prehistoric and historic archaeological sites, and paleontological deposits which would be destroyed or displaced by direct construction activities or indirectly disturbed through increased access to project areas.

Procedural guidelines for implementing the Act have been prepared and released by a number of federal agencies, including the Council on Environmental Quality (1971), and the Corps of Engineers (1970, 1971) and rating scales for environmental evaluation has been circulated (Leopold, et al 1971, Whitman et al 1971). Although most of these provide some clarification of the Environmental Policy Act, the entire area of methodology, breadth of data, and data presentation are treated in insufficient detail. In general the scope of compliance with Public Law 91-190 has not been explicitly defined nor has sufficient attention been directed toward the problems of data deficiency.

Implicit in the present operational guidelines is the assumption that current scientific studies are adequate for an examination of environmental impact. Comprehensive review of published literature in the Trinity River of Texas indicates that the assumption is ill-founded. The results of this study show that none of the areas to be affected by construction have had sufficient scientific study to provide the data necessary for the preparation of environmental impact statements. In addition to the lack of intensive field studies within large areas of the Basin, there are a number of serious problems in the literature. The majority of studies in the past have not been conducted in terms of a research and development framework and therefore have not collected information which can be utilized to answer questions of scientific significance of resources.

Most of the published literature is highly taxonomic and descriptive in nature; minimal attention has been directed to the comparative aspect of resources and few projects have been initiated which attempt distributional studies. Particularly lacking are studies focused on the habitat requirements of particular botanical and zoological species. Thus the definition of specific habitats and the results of habitat alteration within the Trinity system cannot be evaluated until the conclusion of a series of long term studies.

The resolution of problems noted during a review of the literature is more complex than it initially appears, and does not simply involve the initiation of field studies. One of the critical areas in prior work has been the lack of a coordinated framework for investigations within the Trinity Basin. The initial step must entail a precise clarification of the kinds of data necessary within resource management programs. It is suggested that the appropriate mechanism for development of a coordinated framework would be a Corps of Engineers Division-level symposium with representatives from the disciplines of paleontology, geology, zoology, botany, history and archaeology drawn from the major educational and scientific institutions within the State of Texas. It is suggested here that the development of a coordinated program would avoid needless duplication of effort on the part of the several institutions during field studies and insure that comparable data would be available for management projects.

Discussion among the several authors of this report led to the conclusion that future studies should be conducted in terms of the various ecological zones which occur within the Basin rather than on a piece-meal basis. It is further concluded that research confined solely to construction areas will lead to considerable skewness within the data, thus precluding proper assessment of resource significance. It is suggested that studies should cross out the several topographic situations within and adjacent to all construction situations.

Field projects involving either archaeology or paleontology can be feasibly initiated as reconnaissance inventories. Data collection for zoology and botany are inherently more complicated with the concept of inventory much less applicable. In general, studies involving the latter disciplines necessitate long term projects, with field work conducted over the four seasons of the year. It is further doubted that any single institution has the breadth of personnel to conduct all necessary study; thus any single project may involve several institutions.

In summary, a survey of the zoological, botanical, archaeological-historical, and paleontological literature of the Trinity River Basin indicates that there are insufficient data on which to evaluate the impact of construction on the environmental and cultural resources. Extensive scientific studies have not in general been conducted within specific areas which will be altered by reservoir building or canalization activities.

Review of the literature does suggest that the Basin has considerable scientific value from a biological and cultural standpoint. The topographic situations of archaeological and paleontological remains in several areas of the Trinity system are similar to those which will be affected by construction; there is a high degree of likelihood that such resources will occur in project areas. Although minimal ecological studies have been conducted, the distribution of rare plant taxa (Figs. 3-7) indicates a similar situation for botanical species.

Historical remains within construction areas are apparently minimal within the Upper Trinity, although this may be a function of the nature of prior studies. A converse situation exists within the Middle Trinity Basin where a number of important historical sites occur between the proposed Tennessee Colony Reservoir and Lake Livingston. Although much of the literature is deficient in terms of precise locality data, published information indicates that a number of historic sites are within the floodplain and thus will be affected by canalization activity. A few of the remains, including the Spanish Presidio of Bucareli, date to the late eighteenth and early nineteenth century. The majority of sites were occupied between AD 1836 and 1860 and represent technologically the era of river transportation within Texas. Because of their relative uniqueness, every effort should be made to locate, bypass, or otherwise salvage a large sample prior to construction activity.

In conclusion, literature review suggests the necessity for a number of interdisciplinary studies within the Trinity River Basin prior to its alteration.

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