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Survey of Diatoms from Three Streams in Ellis County, Kansas

Mark E. Eberle
Fort Hays State University, meberle@fhsu.edu

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SURVEY OF DIATOMS FROM THREE STREAMS
IN ELLIS COUNTY, KANSAS

being

A Thesis Presented to the Graduate Faculty of
Fort Hays State University
in Partial Fulfillment of the Requirements for
the Degree of Master of Science

by

Mark E. Eberle, B.S.

Fort Hays State University

Date 27 April 1983

Approved

E. L. Wenke
Major Professor

Approved

J. Langthorn
Chairman, Graduate Council

ABSTRACT

Thirty-four genera and 64 species, varieties, and forms of diatoms are reported from a survey of three streams in Ellis County, Kansas. Brief systematic accounts are provided for most of these taxa.

ACKNOWLEDGMENTS

I would like to thank Dr. Thomas Wenke for suggesting this survey and for his assistance throughout the project. Dr. Ruth Patrick of the Academy of Natural Sciences of Philadelphia served as my tutor in diatom taxonomy during the summers of 1979 and 1980; the latter was supported by a travel grant from the McHenry Fund at the Academy. Drs. Jerry Choate, John Ratzlaff, and John Watson reviewed the drafts of this thesis. I would like to also thank Richard and Mildred Eberle of Gwynedd Valley, Pennsylvania, and Hugh and Cyri Eberle of Albuquerque, New Mexico, for providing sustenance while I worked on this project.

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INTRODUCTION

A qualitative survey of diatoms (Bacillariophyta) from Saline River, Big Creek, and Smoky Hill River in Ellis County, Kansas, was conducted in 1979 and 1980. The initial goal of this project was to identify the common diatoms in the county, but, as the literature on diatoms in Kansas was reviewed, it was decided that a comprehensive list of diatoms reported from the state would be useful. This list was to be included in this thesis, but, because of its length, it was published separately (Eberle 1982).

Ellis County is in north-central Kansas at the eastern edge of the High Plains. Average annual precipitation is 23 inches (58 cm). Of this total, about 14 inches (35 cm) of precipitation falls from May through August and less than three inches (7.5 cm) falls from November through February. Except during extended periods of sparse rainfall, Saline River, Big Creek, and Smoky Hill River flow continuously through Ellis County from west to east (fig. 1). In Ellis County these streams are similar physically and chemically. Average discharge of the streams in Ellis and Russell counties is presented in table 1. The pH normally is between 7.5 and 8.5. Specific conductance usually is between 900 and 1700 micromhos per centimeter.

Little is known about the diatomaceous flora of Ellis County and the surrounding area. McFarland (1959) surveyed the algae of Ellis and Trego counties, and his account includes six taxa of diatoms. Selva (1976) studied fossil diatoms from the Ogallala Formation in Ellis, Phillips, and Wallace counties in western Kansas. He later described seven new taxa from those samples (Selva 1981). Czarnecki and Reinke

(1981), McFarland et al. (1964), Reinke (1979 and 1982), and Wujek et al. (1980) published lists of taxa that include diatoms from counties near Ellis County.

METHODS AND MATERIALS

Diatoms were collected from stream substrates of rock, concrete, mud, and submerged plant material. Hard surfaces were scraped and vacuumed with disposable pipettes. Disposable pipettes also were used to collect diatoms from the surface of soft mud. Submerged plant material was placed in small containers and rinsed in the laboratory to remove attached diatoms. Collection localities and habitat descriptions are given in table 2.

Samples were cleaned with hot sulfuric acid as described by Lind (1979). Part of each sample was mounted permanently with Hyrax (Custom Research & Development, Inc., Auburn, California) to a microscope slide and a number one coverslip. Slides from this survey are housed at Fort Hays State University.

Identifications of taxa were made on a Leitz Laborlux microscope with total magnifications of 1000X and 1600X, and a numerical aperture of 1.30. References by Patrick and Reimer (1966 and 1975) were used to identify most taxa in the orders Fragilariales, Achnanthes, Naviculales, and Epithemiales. Hustedt (1930), Hustedt (1927-1966), Schmidt et al. (1874-1959), the card file of new taxa at the Academy of Natural Sciences of Philadelphia, and slides in the herbarium at the Academy were used to identify taxa in the orders Bacillariales, Surirellales, Coscinodiscales, and Biddulphiales, and were used to confirm some taxa keyed with Patrick and Reimer (1966 and 1975). Dr. Ruth Patrick examined some specimens to

confirm identifications and to make suggestions that helped me identify taxa that were difficult to key.

The classification outlined on the next three pages is based primarily on the classification systems of Patrick and Reimer (1966 and 1975), Patrick (pers. comm.), and Simonsen (1979). It includes only those families, subfamilies, and genera that were identified from Ellis County. Those genera marked with an asterisk were identified in the collections, but the species and variety of these valves could not be determined satisfactorily.

Division BACILLARIOPHYTA

Class BACILLARIOPHYCEAE

Order COSCINODISCALES

Family MELOSIRACEAE

Genus *Melosira* Ag. *

Family THALASSIOSIRACEAE

Genus *Cyclotella* Kütz. *

Genus *Stephanodiscus* Ehr. *

Genus *Thalassiosira* Cl. *

Order RHIZOLENIALES

no taxa in this order were collected

Order BIDDULPHIALES

Family BIDDULPHIACEAE

Genus *Biddulphia* Gray

Order FRAGILARIALES

Family FRAGILARIACEAE

Subfamily DIATOMOIDEAE

Genus *Diatoma* Bory

Genus *Meridion* Ag.

Subfamily FRAGILARIOIDEAE

Genus *Fragilaria* Lyngb.

Genus *Synedra* Ehr.

Order EUNOTIALES

no taxa in this order were collected

Order ACHNANTHALES

Family ACHNANTHALES

Subfamily COCCONEIOIDEAE

Genus *Cocconeis* Ehr.

Subfamily ACHNANTHOIDEAE

Genus *Achnanthes* Bory

Genus *Rhoicosphenia* Grun.

Order NAVICULALES

Family NAVICULACEAE

Subfamily NAVICULOIDEAE

Genus *Anomoeoneis* Pfitz.

Genus *Caloneis* Cl.

Genus *Diploneis* Ehr. *

Genus *Frustulia* Rabh.

Genus *Gyrosigma* Hass.

Genus *Mastogloia* Thw. ex W. Sm.

Genus *Navicula* Bory

Genus *Neidium* Pfitz. *

Genus *Pinnularia* Ehr. *

Genus *Plagiotropis* Pfitz.

Genus *Pleurosigma* W. Sm.

Genus *Stauroneis* Ehr.

Subfamily GOMPHOCYMBELLOIDEAE

Genus *Amphora* Ehr. ex Kütz.

Genus *Cymbella* Ag.

Genus *Gomphonema* Ehr.

Order EPITHEMIALES

Family EPITHEMIACEAE

Genus *Rhopalodia* O. Müll.

Order BACILLARIALES

Family BACILLARIACEAE

Genus *Bacillaria* Gmelin

Genus *Hantzschia* Grun.

Genus *Nitzschia* Hass.

Order SURIRELLALES

Family SURIRELLACEAE

Subfamily SURIRELLOIDEAE

Genus *Cymatopleura* W. Sm.

Genus *Surirella* Turp.

Genus *Entomoneis* Ehr.

Available evidence indicates that this genus belongs in Surirellales, but whether it belongs in its own family and/or subfamily is uncertain. *Plagiotropis* Pfitzer traditionally has been placed in the same family or subfamily as *Entomoneis*, but in this manuscript it has been left in Naviculoideae because I have not seen any research that indicates its proper relationship.

SYSTEMATIC ACCOUNTS

Genera are arranged in the same order as listed on pages 4-6, with species, varieties, and forms listed alphabetically within each genus. Each entry includes ranges of variation for taxonomic characters of individuals collected in this survey. Ranges given by the authority cited in each entry are listed in parentheses. Unless otherwise noted, individuals observed in this study fit the description in the reference cited with the taxonomic characters. Because this is a preliminary qualitative survey, only general statements are included for distribution, habitat, and relative abundance of each taxon.

Biddulphia laevis Ehr. var. *laevis*

Striae: 14-15/10 μm	(15-16/10 μm)
Punctae: 13-15/10 μm	
Diameter: 44-50 μm	(50-120 μm)
Elmore (1921:43,213)	

Relatively few valves were collected from a concrete bridge support in Saline River. Reinke (1982) reported this species from several localities in 13 counties in Kansas. Among these was a salt marsh in Russell County within the Saline River drainage basin. Prior to this, its known distribution was limited to salt marshes in Stafford County, two streams in Meade County, and Kansas River.

Diatoma vulgare Bory var. *vulgare*

Striae: unresolved	(about 16/10 μm)
Costae: 5-8/10 μm	(6-8/10 μm)
Length: 40-50 μm	(30-60 μm)
Breadth: 11-14 μm	(8-13 μm)

Patrick and Reimer (1966:109,167)

Individuals were collected from various substrates in Saline and Smoky Hill rivers. McFarland (1959) reported this taxon as common throughout Ellis and Trego counties. Wujek et al. (1980) reported it from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Meridion circulare (Grev.) Ag. var. *circulare*

Striae: 15-17/10 μm	(15-16/10 μm)
Costae: 3-6/10 μm	(3-5/10 μm)
Length: 14-19 μm	(12-80 μm)
Breadth: 7 μm	(4-8 μm)

Patrick and Reimer (1966:113,167)

This taxon was rare in a collection from a concrete bridge support in Saline River. Selva (1976) reported late Tertiary fossils of this species from Ellis County.

Fragilaria brevistriata Grun. var. *brevistriata*

Striae: 12-14/10 μm	(13-17/10 μm)
Length: 19-26 μm	(12-28 μm)
Breadth: 5-6 μm	(3-5 μm)

Patrick and Reimer (1966:128-129,171)

Individuals were collected from substrates of mud and organic debris where no current was detectable in Smoky Hill River. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Fragilaria brevistriata var. *inflata* (Pant.) Hust.

Striae: 12-14/10 μm	(12-16/10 μm)
Length: 11-20 μm	(10-20 μm)
Breadth: 6-7 μm	(3.5-11 μm)

Patrick and Reimer (1966:129,171)

As with the nominate variety, individuals were collected from substrates of mud and organic debris where no current was detectable in Smoky Hill River. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Fragilaria construens var. *venter* (Ehr.) Grun.

Striae: 12-16/10 μm	(14-16/10 μm)
Length: 5-9 μm	(5-9 μm)
Breadth: 4-6 μm	(3-6 μm)

Patrick and Reimer (1966:126,171)

This taxon was collected from various substrates in Saline and Smoky Hill rivers. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Synedra fasciculata (Ag.) Kütz. var. *fasciculata*

Striae: 12-14/10 μm	(10-14/10 μm)
Length: 67-104 μm	(usually 175-250 μm)
Breadth: 4-6 μm	(4-7 μm)
Patrick and Reimer (1966:141,173)	

Individuals were collected from substrates in Saline River with weak current and in isolated pools on the edge of the stream.

Synedra pulchella Ralfs ex Kütz. var. *pulchella*

Striae: 13/10 μm	(12-16/10 μm)
Length: 107 μm	(33-150 μm)
Breadth: 6 μm	(5-8 μm)
Patrick and Reimer (1966:146,175)	

Only one individual of this taxon was seen in a sample from a concrete bridge support in Saline River. It might be a contaminant and is mentioned in the event that further study documents its occurrence in western Kansas.

Synedra ulna (Nitz.) Ehr. var. *ulna*

Striae: 8-11/10 μm	(9-11/10 μm)
Length: 125-265 μm	(50-350 μm)
Breadth: 7-10 μm	(5-9 μm)
Patrick and Reimer (1966:148-149,177)	

This diatom was collected from various substrates in Saline River, Big Creek, and Smoky Hill River. McFarland (1959) regarded this species as common in Ellis and Trego counties. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Cocconeis pediculus Ehr. var. *pediculus*

Striae (araphe valve; axial area):	16-17/10 μm	(18/10 μm)
Striae (araphe valve; margin):	15-16/10 μm	(15-16/10 μm)
Striae (raphe valve; axial area):	18-20/10 μm	(20/10 μm)
Striae (raphe valve; margin):	14-17/10 μm	(16-17/10 μm)
Length:	22-31 μm	(11-30 μm)
Breadth:	19-23 μm	(6-20 μm)
Patrick and Reimer (1966:240,285)		

This taxon was collected from Saline and Smoky Hill rivers.

Cocconeis placentula var. *lineata* (Ehr.) V.H.

Striae (araphe valve):	20-24/10 μm	(19-20/10 μm)
Striae (raphe valve):	18-20/10 μm	(19-23/10 μm)
Length:	20-26 μm	(10-70 μm)
Breadth:	11-13 μm	(8-40 μm)
Patrick and Reimer (1966:242,285)		

This taxon was collected from Saline River, Big Creek, and Smoky Hill River. Some araphe valves from Ellis County have denser striae than the range given by Patrick and Reimer (loc. cit.).

Achnanthes hungarica (Grun.) Grun. var. *hungarica*

Striae (araphe valve): 18-20/10 μm	(19-23/10 μm)
Striae (raphe valve): 17-20/10 μm	(19-23/10 μm)
Length: 17-34 μm	(14-45 μm)
Breadth: 7-8 μm	(6-8 μm)
Patrick and Reimer (1966:259,287)	

This diatom was found only in a collection from submerged concrete in standing water in the original channel of Big Creek on the Fort Hays State University campus. Selva (1976) reported late Tertiary fossils of this species from Ellis County.

Achnanthes lanceolata Bréb. ex Kütz. var. *lanceolata*

Striae (araphe valve): 11-14/10 μm	(11-14/10 μm)
Striae (raphe valve): 11-13/10 μm	(11-14/10 μm)
Length: 9-22 μm	(12-31 μm)
Breadth: 5-7 μm	(4.5-8 μm)
Patrick and Reimer (1966:269,291)	

This taxon was collected from Saline River and Big Creek. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Achnanthes lanceolata var. *dubia* Grun.

Striae (araphe valve): 11-13/10 μm	(10-14/10 μm)
Striae (raphe valve): 11-15/10 μm	(10-14/10 μm)
Length: 9-14 μm	(8-16 μm)
Breadth: 5-7 μm	(3.6-5 μm)
Patrick and Reimer (1966:271,291)	

This taxon was collected from Saline and Smoky Hill rivers. Valves from Ellis County were broader than the range given by Patrick and Reimer (loc. cit.). Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Rhoicosphenia curvata (Kütz.) Grun. ex Rabh. var. *curvata*

Striae (rudimentary raphe valve): 8-11/10 μm (11-13/10 μm)

Striae (raphe valve): 9-10/10 μm (9-15/10 μm)

Length: 21-54 μm (12-75 μm)

Breadth (girdle view): 7-10 μm

Breadth (valve view): 7 μm (4-8 μm)

Patrick and Reimer (1966:282-283,339)

Individuals were collected from various substrates in Saline and Smoky Hill rivers. Striae on the rudimentary raphe valve of specimens from Ellis County were not as dense as the range given by Patrick and Reimer (loc. cit.). Reinke (1979) reported this taxon from Smoky Hill River downstream from Cedar Bluff Reservoir in Trego County. Selva (1976) reported late Tertiary fossils of this taxon from Ellis County.

Anomoeoneis sphaerophora (Ehr.) Pfitz. var. *sphaerophora*

Striae: 14-15/10 μm (15-17/10 μm)

Length: 56-61 μm (30-80 μm)

Breadth: 18-19 μm (13-22 μm)

Patrick and Reimer (1966:374-375,425)

Few individuals were collected from the muddy bottom of Smoky Hill River. No current was detectable over this substrate. Selva (1976) reported late Tertiary fossils of this taxon from Ellis County.

Caloneis lewisii Patr. var. *lewisii*

Striae: 15-18/10 μm (18-20/10 μm)

Length: 31-41 μm (27-42 μm)

Breadth: 8.5-11 μm (8-11 μm)

Patrick and Reimer (1966:588-589,649)

Individuals were collected from Saline River. These valves seem to fit the description of *C. lewisii* given by Patrick and Reimer (loc. cit.). Other valves that I consider to be *Caloneis limosa* (discussed below) were collected from the same locality. The variability of taxonomic characters used to distinguish these and similar taxa of *Caloneis* observed in this population and other populations in Kansas makes it questionable that these taxa are distinct species. Further study is necessary to confirm or modify the systematics of these taxa.

Caloneis limosa (Kütz.) Patr. var. *limosa*

Striae: 16-20/10 μm (16-20/10 μm)

Length: 25-45 μm (22-50 μm)

Breadth: 6.5-11.5 μm (8-14 μm)

Patrick and Reimer (1966:587-588,649)

This taxon was collected from muddy substrates in Saline and Smoky Hill rivers. Some valves in samples from Saline River and other localities in Kansas have a transverse fascia which should be absent according to Patrick and Reimer (loc. cit.). The distinction between this taxon and *Caloneis lewisii* (discussed above) seems to be questionable based on observations of populations in Kansas.

Frustulia vulgaris (Thw.) DeT. var. *vulgaris*

Transverse striae: 24-25/10 μm (24/10 μm)

Length: 53-54 μm (50-70 μm)

Breadth: 10-11 μm (10-13 μm)

Patrick and Reimer (1966:309-310,343)

Few individuals were collected from a concrete bridge support in Saline River. Curtis (1901) might have collected this taxon (see Eberle 1982:49-50), and it was reported from Kansas as a late Tertiary fossil (Chaney and Elias 1938). In addition to specimens from Ellis County, this species has been verified from Cherokee County, Kansas (Wenke and Eberle, submitted).

Gyrosigma acuminatum (Kütz.) Rabh. var. *acuminatum*

Transverse striae: 16-18/10 μm (16-18/10 μm)

Longitudinal striae: 18-21/10 μm (17-20/10 μm)

Length: 91-122 μm (60-125 μm)

Breadth: 12-16 μm (12-16 μm)

Patrick and Reimer (1966:314-315,345)

This taxon was collected from Saline and Smoky Hill rivers. It is similar to *Gyrosigma spenceri* which has a few more striae in 10 μm and has a slightly eccentric, undulate raphe. In a number of valves from Ellis County, the raphe appeared to be slightly eccentric and undulate on one-half of the valve, but was central and not undulate on the other half of the valve. Overall, these valves seem to fit the description of *G. acuminatum* best.

Mastogloia elliptica var. *danseii* (Thw.) Cl.

Striae: 15-16/10 μm	(16-18/10 μm)
Loculi: 7-8/10 μm	(8-10/10 μm)
Length: 39-41 μm	(20-51 μm)
Breadth: 11-12 μm	(11-15 μm)

Patrick and Reimer (1966:300-301,339)

Few individuals were collected from a concrete bridge support in Saline River.

Navicula cuspidata (Kütz.) Kütz. var. *cuspidata*

Transverse striae: 11-16/10 μm	(14-24/10 μm)
Length: 48-120 μm	(30-120 μm)
Breadth: 18-28 μm	(15-25 μm)

Patrick and Reimer (1966:464,551)

This taxon was collected from Saline River, Big Creek, and Smoky Hill River. Both morphological types discussed by Patrick and Reimer (loc. cit.) were observed in these collections. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Navicula lanceolata (Ag.) Kütz. var. *lanceolata*

Striae: 8-12/10 μm	(about 10/10 μm)
Length: 22-51 μm	(27-50 μm)
Breadth: 6-11.5 μm	(6.5-12 μm)
Patrick and Reimer (1966:511-512,561)	

This species was collected from various substrates in Saline River, Big Creek, and Smoky Hill River. Selva (1976) reported late Tertiary fossils of this taxon from Ellis County.

Navicula pupula var. *capitata* Skv. & Meyer

Striae: 15-16/10 μm	(13-17/10 μm)
Length: 25-30 μm	(20-40 μm)
Breadth: 7-7.5 μm	(7-11 μm)
Patrick and Reimer (1966:496,559)	

Few individuals were collected from Smoky Hill River.

Navicula pygmaea Kütz. var. *pygmaea*

Striae: 20-25/10 μm	(24-26/10 μm)
Length: 26-32 μm	(16-45 μm)
Breadth: 12-12.5 μm	(8-24 μm)
Patrick and Reimer (1966:442,543)	

Frustules of this taxon were rare in collections from Saline River. Wujek et al. (1980) reported this species from Cedar Bluff Reservoir on Smoky Hill River in Trego County. Selva (1976) reported late Tertiary fossils of this taxon from Ellis County.

Navicula salinarum var. *intermedia* (Grun.) Cl.

Striae: 12-14/10 μm (14-18/10 μm)

Length: 29-32.5 μm (25-50 μm)

Breadth: 7-8 μm (7-10 μm)

Patrick and Reimer (1966:503,561)

This taxon was collected from muddy substrate in Smoky Hill River. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Navicula viridula var. *rostellata* (Kütz.?) Cl.

Striae: 8-10/10 μm (9-12/10 μm)

Length: 37-39 μm (35-65 μm)

Breadth: 8.5-9 μm (8-11 μm)

Patrick and Reimer (1966:507-508,561)

This taxon was collected from Saline and Smoky Hill rivers.

Pinnularia sp.

Striae: 6-7/10 μm

Length: 110-170 μm

Breadth: 19-26 μm

This taxon resembles *Pinnularia ruttneri* Hustedt (Patrick and Reimer 1966:638-639,669). It differs in that the longitudinal band that crosses the striae becomes broader near the apices. *P. ruttneri* is found in acidic freshwater of low mineral content. We collected our specimens from Smoky Hill River (Ellis County) and St. Jacob's Well (Clark County), neither of which is acidic or of "low" mineral content.

Plagiotropis lepidoptera var. *proboscidea* (Cl.) Reim.

Striae: 15-16/10 μm (16-18/10 μm)

Length: 81-86 μm (45-85 μm)

Breadth: 19-20 μm (16-19 μm)

Patrick and Reimer (1975:7-8,13)

This taxon was collected from various substrates in Saline and Smoky Hill rivers.

Pleurosigma delicatulum W. Sm. var. *delicatulum*

Striae (diagonal and transverse): 19-24/10 μm (20-25/10 μm)

Length: 133-190 μm (130-280 μm)

Breadth: 15.5-17 μm (13-19 μm)

Patrick and Reimer (1966:336-337,355)

This taxon was collected from Saline and Smoky Hill rivers from muddy stream bottoms and a submerged branch. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Stauroneis phoenicenteron (Nitz.) Ehr. var. *phoenicenteron*

Striae: 12/10 μm (12-17/10 μm)

Length: 115 μm (70-380 μm)

Breadth: 26 μm (16-53 μm)

Patrick and Reimer (1966:359,419)

Only one individual was found in a collection from Smoky Hill River. It was collected from the muddy stream bottom where no current was detectable. This might be a contaminant and is mentioned in the event that further study documents living cells from western Kansas.

Amphora ovalis var. *affinis* (Kütz.) V.H. ex Det.

Striae: 10-13/10 μm (11-12/10 μm)

Length: 21-52 μm (28-80 μm)

Breadth: 6-9 μm (7-12 μm)

Patrick and Reimer (1975:69,103)

Individuals were collected from various substrates in Saline and Smoky Hill rivers.

Amphora sp.

Striae: 9/10 μm

Length: 34-38 μm

Breadth: 7-8.5 μm

This taxon resembles *Amphora acutiuscula* Kützing in shape, but has a shortened, dorsal striae in the center that is more distant from the adjacent striae than they are from each other. Individuals were collected from Saline and Smoky Hill rivers.

Cymbella affinis Kütz. var. *affinis*

Striae (dorsal): 7-8/10 μm (9-11/10 μm)

Striae (ventral): 8-10/10 μm (9-11/10 μm)

Length: 24.5-32 μm (20-50 μm)

Breadth: 8.5-9.5 μm (7-12 μm)

Patrick and Reimer (1975:57-58,97)

This species was collected from muddy substrate in Smoky Hill River.

Cymbella minuta var. *silesiaca* (Bleisch ex Rabh.) Reim.

Striae: 10-12/10 μm (11-13/10 μm)

Length: 18-23 μm (18-40 μm)

Breadth: 6-7 μm (7-9 μm)

Patrick and Reimer (1975:49-50,93)

This taxon was collected from standing water in the original channel of Big Creek (now by-passed by a flood control channel). Reimer (Patrick and Reimer, loc. cit.) mentioned that the separation of this variety and the nominate variety is questionable and deserves further study. One valve I observed had one apex somewhat protracted (Patrick and Reimer 1975:93, fig. 3), as illustrated for *C. minuta* var. *minuta*, and had one apex not protracted (Patrick and Reimer 1975:93, fig. 9-10). Because *C. minuta* var. *minuta* is known to be highly variable, the valves listed here as *C. minuta* var. *silesiaca* later might be submerged with the nominate variety. This taxon has been reported previously from Kansas only as a late Tertiary fossil (Selva 1976), but recently was collected from Shoal Creek, Cherokee County, Kansas (Wenke and Eberle, submitted).

Cymbella sinuata Greg. var. *sinuata*

Striae: 8-9/10 μm (9-14/10 μm)

Length: 21-27 μm (11-40 μm)

Breadth: 6-7 μm (3.5-9 μm)

Patrick and Reimer (1975:51,95)

Individuals were collected from Smoky Hill River.

Cymbella triangulum (Ehr.) Cl. var. *triangulum*

Striae: 7-8/10 μm	(8-11/10 μm)
Length: 50-66 μm	(30-70 μm)
Breadth: 17-21 μm	(13-20 μm)

Patrick and Reimer (1975:45,91)

This species was collected from Smoky Hill River. Valves that could not be identified satisfactorily from Saline River might be of this taxon.

Cymbella tumida (Bréb. ex Kütz.) V.H. var. *tumida*

Striae: 8-9/10 μm	(8-10/10 μm)
Length: 52-63 μm	(35-80 μm)
Breadth: 16-18 μm	(12-18 μm)

Patrick and Reimer (1975:58,97)

Individuals were collected from Saline River and Big Creek.

Gomphonema olivaceum (Lyngb.) Kütz. var. *olivaceum*

Striae: 8-11/10 μm	(11-14/10 μm)
Length: 16-35 μm	(15-40 μm)
Breadth: 5-8 μm	(5-10 μm)

Patrick and Reimer (1975:139-140,161)

This species was collected from various substrates in Saline River, Big Creek, and Smoky Hill River. The number of striae in 10 μm is less than the range given by Patrick and Reimer (loc. cit.), but the valves observed otherwise fit the description of this taxon. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Gomphonema parvulum (Kütz.) Kütz. var. *parvulum*

Striae: 10-12/10 μm	(8-19/10 μm)
Length: 17-24 μm	(15-30 μm)
Breadth: 5.5-7 μm	(4-8 μm)

Patrick and Reimer (1975:122-123,159)

Individuals were collected from Saline River and Big Creek. This is a variable taxon and much of the known variation was observed in specimens from Ellis County.

Gomphonema subclavatum (Grun.) Grun. var. *subclavatum*

Striae: 7-9/10 μm	(9-13/10 μm)
Length: 28-61 μm	(35-70 μm)
Breadth: 8-12.5 μm	(8-10 μm)

Patrick and Reimer (1975:129,157)

This variety was collected from Saline and Smoky Hill rivers. It is a variable taxon and individuals similar to this species and other, "related" taxa that could not be identified satisfactorily were observed in collections from all three streams. Selva (1976) reported this species from Ellis County as a late Tertiary fossil.

Gomphonema truncatum Ehr. var. *truncatum*

Striae: 9-10/10 μm	(10-12/10 μm)
Length: 44 μm	(26-65 μm)
Breadth: 9.5-10.5 μm	(6-14 μm)

Patrick and Reimer (1975:118-119,157)

Individuals were collected from a concrete bridge support in Saline River. It has been reported only once from Kansas since 1901, by Wujek et al. (1980) from Meade County. I also collected specimens of this taxon from an isolated stock tank on Mesa de Maya in southeastern Colorado.

Rhopalodia gibba var. *ventricosa* (Kütz.) H. & M. Perag.

Striae: difficult to resolve	(12-16/10 μm)
Costae: 6-8/10 μm	(5-8/10 μm)
Length: 43-71 μm	(25-100 μm)
Breadth (valve): 7.5-11.5 μm	(7-10 μm)
Patrick and Reimer (1975:190,207)	

This taxon was collected from various substrates in Saline River. All of the valves observed were swollen laterally to some degree, but varied from being nearly linear to broadly inflated (Patrick and Reimer 1975:207, fig. 3). *Rhopalodia gibba* var. *gibba* is longer and more linear (only slightly inflated in the center) than *R. gibba* var. *ventricosa*, and the valves collected in Ellis County fit the description of *R. gibba* var. *ventricosa* best. This variety has been reported from Kansas only by Curtis (1901) and the Academy of Natural Sciences of Philadelphia (1958). *R. gibba* var. *gibba* has been reported from Kansas in at least eight publications (see Eberle 1982:118).

Rhopalodia musculus (Kütz.) O. Müll. var. *musculus*

Striae: difficult to resolve	(12-16/10 μm)
Costae: 3-5/10 μm	(3-5/10 μm)
Length: 23-33.5 μm	(30-80 μm)
Breadth (frustule): 27-28 μm	(10-40 μm)
Breadth (valve): 6.5-10.5 μm	(11-15 μm)
Patrick and Reimer (1975:191,207)	

This species was collected from various substrates in Saline River. Valves from Ellis County are shorter and narrower than the range given by Patrick and Reimer (loc. cit.). Several valves looked like the specimen illustrated by Patrick and Reimer (1975:207, fig. 5), but had apices that were bent ventrally as illustrated for *Rhopalodia gibberula* var. *vanheureka* (Patrick and Reimer 1975:207, fig. 7). Patrick and Reimer (loc. cit.) stated that *R. musculus* and *R. gibberula* are variable species and might intergrade. *R. musculus* has been reported from Kansas only by the Academy of Natural Sciences of Philadelphia (1958).

Bacillaria paradoxa Gmelin var. *paradoxa*

Striae: 19-22/10 μm	(20-25/10 μm)
Fibulae: 6-8/10 μm	(6-8/10 μm)
Length: 87-110 μm	(60-150 μm)
Breadth: 5-6.5 μm	(4-8 μm)
Hustedt (1930:396-397)	

This taxon was collected from Saline and Smoky Hill rivers.

Hantzschia amphioxys (Ehr.) Grun. var. *amphioxys*

Striae: 20/10 μm	(13-20/10 μm)
Fibulae: 8/10 μm	(5-8/10 μm)
Length: 44 μm	(20-100 μm)
Breadth: 7.5 μm	(5-10 μm)
Hustedt (1930:394)	

Only one valve of this taxon could be identified satisfactorily in a collection from Saline River. It seems to be a variable species and this form also might occur in collections from Big Creek (see next taxonomic account).

Hantzschia amphioxys var. *amphioxys* f. *capitata* O. Müll.

Striae: about 22/10 μm	(13-20/10 μm)
Fibulae: 4-6/10 μm	(5-8/10 μm)
Length: 28.5 μm	(20-100 μm)
Breadth: 5 μm	(5-10 μm)
Hustedt (1930:394)	

Only one valve could be identified satisfactorily in a collection from Big Creek. As with the nominate form, other individuals were observed in Saline River and Big Creek that looked similar to this taxon, but they did not clearly fit the description of Hustedt (loc. cit.). Selva (1976) reported late Tertiary fossils of this form from Ellis County.

Hantzschia amphioxys var. *vivax* Grun.

Striae: 15/10 μm	(13-20/10 μm)
Fibulae: 6-7/10 μm	(5-8/10 μm)
Length: 68 μm	(100-200 μm)
Breadth: 7 μm	(13-15 μm)
Hustedt (1930:394)	

Only one individual was collected from Saline River. Other taxa of this apparently variable species have been collected from Saline River and Big Creek. Selva (1976) reported late Tertiary fossils of this variety from Ellis County.

Nitzschia acicularis (Kütz.) W. Sm. var. *acicularis*

Striae: not distinguishable	(very fine)
Fibulae: 14-16/10 μm	(17-20/10 μm)
Length: 69-98 μm	(50-150 μm)
Breadth: 4-5 μm	(3-4 μm)
Hustedt (1930:423-424)	

This taxon was collected from Big Creek and Smoky Hill River. I am not aware of a recent, comprehensive study of this and similar taxa, so I am uncertain as to which name applies to specimens from Ellis County. The fibulae are not as dense as the range given by Hustedt (loc. cit.), but Elmore (1921) lists the range as 12-18/10 μm . The apices of most of the valves observed were curved in opposite directions, but some were curved in the same direction or were nearly straight. McFarland (1959) reported this taxon from Ellis

and/or Trego counties. Wujek et al. (1980) collected this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County. McFarland et al. (1964) reported this diatom from Barton County (southeast of Ellis County) as *Nitzschia reversa* W. Smith.

Nitzschia amphibia Grun. var. *amphibia*

Striae: 15-18/10 μm	(15-19/10 μm)
Fibulae: 6-8/10 μm	(7-9/10 μm)
Length: 17-23.5 μm	(12-50 μm)
Breadth: 4-4.5 μm	(3-5 μm)
Hustedt (1930:414)	

This taxon was collected from Saline River and Big Creek. Wujek et al. (1980) reported this species from Cedar Bluff Reservoir on Smoky Hill River in Trego County. Selva (1976) reported late Tertiary fossils of this taxon from Ellis County.

Nitzschia apiculata (Greg.) Grun. var. *apiculata*

Striae: 13-16/10 μm	(17-20/10 μm)
Fibulae: not distinguishable	(not distinguishable)
Length: 31-58 μm	(20-50 μm)
Breadth: 5-8.5 μm	(5-8 μm)
Hustedt (1930:401-402)	

Individuals were collected from Saline River, Big Creek, and Smoky Hill River. The density of striae is lower than that given by Hustedt (loc. cit.), but the specimens from Ellis County fit this

taxon better than any other. Wujek et al. (1980) reported this species from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Nitzschia dissipata (Kütz.) Grun. var. *dissipata*

Striae: indistinct	(very fine)
Fibulae: 8-9/10 μm	(6-8/10 μm)
Length: 30.5 μm	(15-70 μm)
Breadth: 4.5 μm	(4-7 μm)

Hustedt (1930:412)

Only one individual was collected from a small, isolated pool along Saline River. Wujek et al. (1980) reported this species from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Nitzschia hungarica Grun. var. *hungarica*

Striae: 17-19/10 μm	(16-20/10 μm)
Fibulae: 8-10/10 μm	(7-9/10 μm)
Length: 52-63 μm	(20-110 μm)
Breadth: 6.5-9 μm	(6-9 μm)

Hustedt (1930:401-402)

This species was collected from Saline River, Big Creek, and Smoky Hill River. It was reported by Wujek et al. (1980) from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Nitzschia linearis W. Sm. var. *linearis*

Striae: very fine	(about 28-30/10 μm)
Fibulae: 10-12/10 μm	(8-13/10 μm)
Length: 96-156 μm	(70-180 μm)
Breadth: 4.5-5.5 μm	(5-6 μm)
Hustedt (1930:409-410)	

This taxon was collected from Big Creek and Smoky Hill River.

Nitzschia sigma (Kütz.) W. Sm. var. *sigma*

Striae: about 26-32/10 μm	(about 22-30/10 μm)
Fibulae: 8-11/10 μm	(7-12/10 μm)
Length: 127-220 μm	(over 50 μm)
Breadth: 6.5-7.5 μm	(4-15 μm)
Hustedt (1930:418,420-421)	

This species was collected from Saline and Smoky Hill rivers.

Nitzschia sp.

Striae: 10-15/10 μm
Punctae: about 12-19/10 μm
Fibulae: not distinguishable
Length: 22-52.5 μm
Breadth: 6-7.5 μm

Individuals were collected from Saline and Smoky Hill rivers. They look similar to *Nitzschia rautenbachiae* Cholnoky (Cholnoky 1957:70, fig. 228-232) which has the following characteristics:

Striae: about 12/10 μm

Punctae: about 10/10 μm , transapically elongate

Length: 16-55 μm

Breadth: 5-6 μm

The specimens from Ellis County have denser punctae that do not seem to be transapically elongate when viewed with the light microscope. Selva (1976) photographed late Tertiary fossils that look similar to the taxon I observed and he identified these as *Nitzschia angustata* (W. Smith) Grunow. Hustedt (1930) stated that *N. angustata* has finely punctate striae, but this is not the case with the specimens I observed or Selva photographed.

Cymatopleura elliptica (Bréb.) W. Sm. var. *elliptica*

Alar canals: 3-4/10 μm (2.5-5/10 μm)

Length: 86-107 μm (50-220 μm)

Breadth: 44-49 μm (40-90 μm)

Hustedt (1930:426-428)

This species was collected from the muddy stream bottom of Smoky Hill River.

Cymatopleura solea (Bréb.) W. Sm. var. *solea*

Alar canals: 6-9, 12/10 μm (6-9/10 μm)

Length: 75-110 μm (30-300 μm)

Breadth (center): 17-23 μm (12-40 μm)

Breadth (widest point): 19-28 μm

Hustedt (1930:425-426)

This taxon was collected from various substrates in Saline River, Big Creek, and Smoky Hill River. The degree of undulation varied with the length of the frustule. Shorter cells (75-78 μm) were only 1 μm narrower at the central constriction than at the widest point, while longer cells (89-110 μm) were 5-7 μm narrower at the central constriction. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Surirella angusta Kütz. var. *angusta*

Striae: about 17-20/10 μm

Alar canals: 5-7/10 μm (6-7.5/10 μm)

Length: 33-50 μm (18-70 μm)

Breadth: 8-10.5 μm (6-15 μm)

Hustedt (1930:435-436)

Individuals were collected from Big Creek and Smoky Hill River.

Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

Surirella ovalis Bréb. var. *ovalis*

Striae: 13-18/10 μm (about 16/10 μm)

Alar canals: 5-6/10 μm (1.5-4.5/10 μm)

Length: 54-84 μm (20-100 μm)

Breadth: 29-36 μm (10-40 μm)

Hustedt (1930:441-442)

This species was collected from Saline River. Frustules from Smoky Hill River that could not be identified looked similar to *S. ovalis* but had a broadly rounded apex.

Surirella ovata Kütz. var. *ovata*

Striae: 16-18/10 μm	(16-20/10 μm)
Alar canals: 5-7/10 μm	(4-7/10 μm)
Length: 23-40 μm	(15-70 μm)
Breadth: 15-22 μm	(8-23 μm)
Hustedt (1930:442-445)	

This taxon was collected from concrete substrates in Saline River and Big Creek. Specimens from Ellis County varied considerably in shape (the characteristic used to distinguish varieties of this species), and further study is needed to determine the full extent of this variation.

Surirella ovata var. *pinnata* (W. Sm.) Brun

Striae: 15-17/10 μm	(16-20/10 μm)
Alar canals: 5-7/10 μm	(4-7/10 μm)
Length: 21-47 μm	(15-70 μm)
Breadth: 7-13 μm	(8-23 μm)
Hustedt (1930:442-445)	

This taxon was collected from Big Creek. One valve observed had a central constriction. It was 47.5 μm long, 15 μm and 13.5 μm wide at the ends, and 9.5 μm wide at the constriction. These constricted valves also were observed in a collection from Smoky Hill River in Russell County.

Entomoneis alata (Ehr.) Ehr. var. *alata*

Striae: 16-18/10 μm	(14-17/10 μm)
Length: 58-89 μm	(55-160 μm)
Breadth (girdle view): 21-22 μm	(30-60 μm)
Patrick and Reimer (1975:3-4,11)	

This species was collected from various substrates in Saline River. I measured the breadth of the frustule at the narrowest point. At the widest point they were about 35 μm wide

Entomoneis paludosa (W. Sm.) Reim. var. *paludosa*

Striae: 21-22/10 μm	(20-24/10 μm)
Length: 38-58 μm	(35-130 μm)
Breadth (girdle view): 20 μm	(20-35 μm)
Patrick and Reimer (1975:4-5,11)	

This taxon was collected from a mud substrate in a small, isolated pool along Saline River. Specimens collected by McFarland and Knudson from localities in Ellis County seem to be of this species, but they are difficult to identify because the few slides available are of uncleaned material. Wujek et al. (1980) reported this taxon from Cedar Bluff Reservoir on Smoky Hill River in Trego County.

SUMMARY

Sixty-four taxa in 28 genera are reported from three streams in Ellis County, Kansas. Six additional genera were observed, but no species in these genera could be identified. Many frustules in all 34 genera could not be identified to the level of species with the resources used in this survey, but some of these should be identifiable when additional, relatively comprehensive references on diatoms become available.

LITERATURE CITED

- Academy of Natural Sciences of Philadelphia (ANSP). 1958. Kansas River Survey. Species list on file with ANSP, Dept. of Limnology. Unpubl. report for E.I. Dupont de Nemours and Co.
- Chaney, R.W. and M.K. Elias. 1938. Late Tertiary floras from the High Plains. Contrib. Paleont., Carnegie Inst.: Washington, D.C. 476:1-46.
- Cholnoky, B.J. 1957. Neue und seltene Diatomeen aus Afrika III. Diatomeen aus dem Tugela-Flußsystem, hauptsächlich aus den Drakensbergen in Natal. Österreichische Botanische Zeitschrift 104:25-99.
- Curtis, G.H. 1910. Some Diatomaceae of Kansas. Trans. Kansas Acad. Sci. 17:67-78.
- Czarnecki, D.B. and D.C. Reinke. 1981. Diatoms new to Kansas and nomenclatural notes on previous reports. Tech. Publ. St. Biol. Surv. Kansas 10:20-31.
- Eberle, M.E. 1982. Annotated list of diatoms reported from Kansas. Fort Hays Stud., Sci.: New (Third) Ser. 1:1-145.
- Elmore, C.J. 1921. The diatoms (Bacillarioideae) of Nebraska. Univ. Nebraska Stud. 21:22-215.
- Hustedt, F. 1927-1966. Die Kieselalgen Deutschlands, Österreichs, und der Schweiz. In: L. Rabenhorst's Kryptogamen-Flora, vol. 8, parts 1-3, 2581 pp. Reprint; Johnson Reprints, Inc., 111 Fifth Ave., N.Y., N.Y., 10003.
- - - - -. 1930. Bacillariophyta (Diatomae). In: A. Pascher, ed. Die Susswasser-Flora Mitteleuropas. Heft 10. Gustav Fischer Verlag: Jena, 466 pp.

- Lind, O.T. 1979. Handbook of Common Methods in Limnology, 2nd ed.
C.V. Mosby Co.: St. Louis, 199 pp.
- McFarland, B.H. 1959. A preliminary survey of the algae of Ellis
and Trego counties. Fort Hays Kansas St. Coll., Hays, Kansas,
unpubl. M.S. thesis, 73 pp.
- McFarland, H.J., E.A. Brazda, and B.H. McFarland. 1964. A
preliminary survey of the algae of Cheyenne Bottoms in Kansas. Fort
Hays Stud. (New Ser.), Sci. Ser. 2:1-80.
- Patrick, R. and C.W. Reimer. 1966. The Diatoms of the United States,
Vol. 1. Monogr. Acad. Nat. Sci. Philadelphia 13:xi + 1-688.
- - - - -. 1975. The Diatoms of the United States, Vol. 2, Part. 1.
Monogr. Acad. Nat. Sci. Philadelphia 13:ix + 1-213.
- Reinke, D.C. 1979. New and interesting algae from Kansas. Tech
Publ. St. Biol. Surv. Kansas 8:67-71.
- - - - -. 1982. New records and distributional notes of Kansas
algae for 1981. Tech. Publ. St. Biol. Surv. Kansas 12:61-79.
- Schmidt, A., M. Schmidt, F. Fricke, H. Heiden, O. Müller, and F.
Hustedt. 1874-1959. Atlas der Diatomeen-Kunde. R. Reisland:
Leipzig, Heft 1-120, Tafeln 1-480.
- Selva, S.B. 1976. A biostratigraphic study of Late Tertiary freshwater
diatoms from the Ogallala of western Kansas. Iowa St. Univ., Ames,
Iowa, unpubl. Ph.D dissert., 188 pp.
- - - - -. 1981. Tertiary freshwater diatoms from the Ogallala of
western Kansas. Proc. Iowa Acad. Sci. 88:85-90.
- Simonsen, R. 1969. The diatom system: Ideas on phylogeny. Bacillaria
2:9-71.

Wujek, D.E., M.S. Chapo, D.C. Reinke. 1980. New records and
distributional notes on diatoms from western Kansas. Tech.
Publ. St. Biol. Surv. Kansas 9:90-109.

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FIGURE 1. Regional map and collection localities [O].

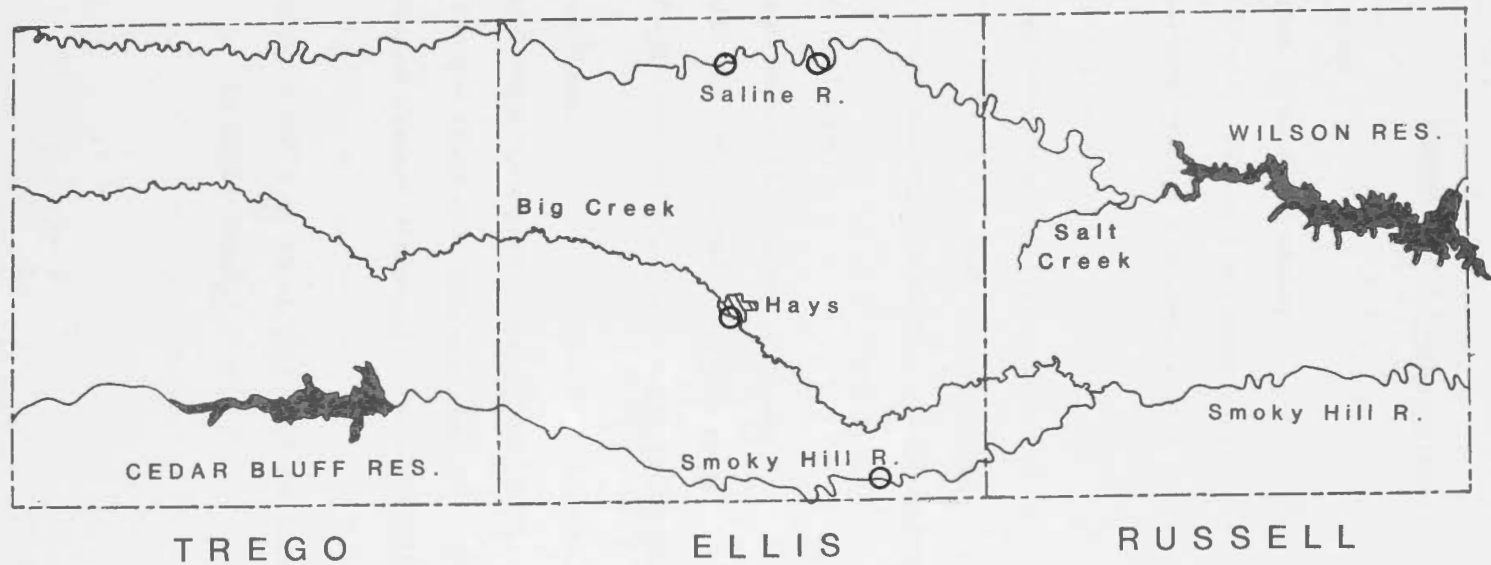


TABLE 1. Discharge data

Big Creek

near Hays, Ellis County

594 mi² (1540 km²) drainage area

33-year average discharge = 38.6 ft³/s (1.09 m³/s)

Smoky Hill River

near Schoenchen, Ellis County

5750 mi² (14,890 km²) drainage area

15-year average discharge = 32.4 ft³/s (0.92 m³/s)

Smoky Hill River

near Bunker Hill, Russell County

7075 mi² (18,320 km²) drainage area

40-year average discharge = 192 ft³/s (5.44 m³/s)

Saline River

near Russell, Russell County

1502 mi² (3890 km²) drainage area

28-year average discharge = 106 ft³/s (3.00 m³/s)

Extremes: 0 ft³/s to about 20,000 ft³/s (flood stage)

in Ellis County.

TABLE 2. Collection localities.

KANSAS: Saline Basin, Saline River; Ellis Co., 16 mi N and 5 mi E of Hays, 4th bridge E of U.S. 183 on FAS 235 (NW $\frac{1}{4}$ Sec. 17, T 11 S, R 17 W);

30 JUN 1979.

Slide 19 - small, isolated pool along edge of stream; muddy bottom; exposed to direct sunlight.

Slide 21 - surface debris behind (upstream) fallen branches; shaded.

KANSAS: Saline Basin, Saline River; Ellis Co., 15.5 mi N and 1 mi E of Hays, U.S. 183 bridge (Sec. 15, T 11 S, R 18 W); 27 FEB 1980.

Slide 30 - backwater around concrete bridge support; diatoms collected from concrete.

KANSAS: Smoky Hill Basin, Big Creek; Ellis Co., Fort Hays St. Univ. campus (SE $\frac{1}{4}$ Sec. 32, T 13 S, R 18 W); 21 FEB 1980.

Slide 24 - standing water of original Big Creek channel at old boat landing between Custer Hall and Sheridan Coliseum; diatoms collected from concrete surface under 1-2 inches of ice.

KANSAS: Smoky Hill Basin, Big Creek; Ellis Co., Fort Hays St. Univ. campus (SE $\frac{1}{4}$ Sec. 32, T 13 S, R 18 W); 12 MAR 1980.

Slides 31 & 33 - same as above without ice for one week.

KANSAS: Smoky Hill Basin, Smoky Hill River; Ellis Co., 0.25 mi N and 0.25 mi W of Pfeifer, bridge N of cemetery (SW $\frac{1}{4}$ Sec. 25, T 15 S, R 17 W); 16 JUN 1979.

Slide 7 - muddy stream bottom, 20 cm deep; no current detectable; exposed to direct sunlight.

TABLE 2 (Continued)

KANSAS: Smoky Hill Basin, Smoky Hill River; Ellis Co., 0.25 mi N and
0.25 mi W of Pfeifer, bridge N of cemetery (SW $\frac{1}{4}$ Sec. 25, T 15 S, R 17 W);
30 JUN 1979.

Slide 16 - wood debris near surface; no current detectable; shaded.