

AN ABSTRACT OF THE THESIS OF

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Title: Riffle Beetles (Coleoptera: Elmidae) of the Cottonwood-Neosho
River Drainage in East-Central Kansas

Abstract approved:

Carl W. Prophet

Between the fall of 1978 and the summer of 1980, the species composition of riffle beetles (Coleoptera: Elmidae) was determined in the Cottonwood-Neosho River drainage near Emporia, Kansas. Thirty-nine sample locations, which represents 23 different streams plus the Cottonwood and Neosho Rivers, were sampled for elmids. Members of eight different elmid species were collected and identified from these locations. Since 1975, the State Biological Survey has reported that nine elmid species have been reported from the study area involved in this project. During the present study, the author collected a new species, Stenelmis sp., which has only been partially described by Alex Slater of the State Biological Survey. This new species was collected in Chase and Lyon Counties, which represents two new county records. It had previously been reported only from Bourbon and Johnson Counties in far eastern Kansas. Also, four other new county records were established for: Stenelmis crenata in Coffey County; Stenelmis decorata in Coffey County; Stenelmis vittipennis in Coffey County; and Microcylloepus pusillus in Lyon County.

During my collections, differences became apparent between the

numbers of S. bicarinata and S. sexlineata in the tributaries of the Cottonwood River and the Cottonwood River. Stenelmis bicarinata comprised approximately 75% of the total number of collected elmids in the Cottonwood River. While in the tributaries of the Cottonwood River, it comprised only 29% of the total number. Meanwhile, S. sexlineata accounted for less than 5% of the total number of collected elmids in the Cottonwood River, but in the tributaries, it comprised 32% of the total. The reason for this is not clear, but could be due to the pollution tolerance of S. sexlineata, and some interspecific competition between the two species.

RIFFLE BEETLES (COLEOPTERA: ELMIDAE)
OF THE COTTONWOOD-NEOSHO RIVER
DRAINAGE IN EAST-CENTRAL KANSAS

A Thesis
Presented to
the Division of Biological Sciences
Emporia State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
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INTRODUCTION

Elmids are small, dark aquatic dryopoid beetles, frequently referred to as riffle beetles because their usual habitat is the riffle areas of streams. Although elmids are more characteristic of lotic environments, some species do inhabit lakes (Leech and Chandler, 1956); for example, Garmache (1977) collected Macronychus glabratus from a pond at a depth of one meter on the campus of the Allen County Community College in Kansas.

These small beetles, the adults of which range in length from less than two mm to greater than four mm, exhibit complete metamorphosis (Brown, 1972). The complete life cycle of only a few of the elmids species has been studied in detail. White (1978) reported that the life cycle of Stenelmis sexlineata required six months to complete, from the time of egg deposition to the adult stage. However, this cycle was determined in the laboratory, and he hypothesized that in nature the life cycle could require one to two years to complete.

The elmids life cycle is almost totally aquatic. The eggs are deposited on the undersides of rocks, and in about seven days the larvae emerge, feeding on algae, detritus, or bryozoans. The larvae either remain on the larger rubble or they crawl to the sandier types of substrates where they bury themselves, exposing only their caudal filamentous gills. The larvae complete seven instars then crawl to the water's edge and pupate in the sand or underneath the stones on the shore. This stage is the only non-aquatic stage in the life cycle of an elmid. After about 10 to 14 days, the adult emerges from the pupal case and is now capable of aerial flight for the only time in its life. Once the adult contacts

the water, it remains submerged, crawling on the undersides of rocks and feeding on algae and detritus.

The majority of the published elmid taxonomic literature is based on larval and adult collections from North, Central, and South America. The adult elmids can be identified to species using Brown's (1972) key. It also contains a taxonomic key to the larvae, but unfortunately they can only be identified to the genus level. Some taxonomic work concerning elmid pupae has also been published, but only a few of the pupae have been identified to the species level (LeSage and Harper, 1976).

The most prevalent elmid genus in North America is Stenelmis. According to Brown (1972), 28 species of Stenelmis are known to occur within the United States, with 12 species occurring in the central Great Plains states of Nebraska, Colorado, Kansas, Missouri, and Oklahoma. The State Biological Survey of Kansas started reporting the elmid species inhabiting Kansas streams in 1976. From 1976 to May 1980, they had reported nine elmid species in the study area selected for this present research. This total includes five members of the Stenelmis genus, two species of Dubiraphia, and single species of both Microcylloepus and Macronychus (Huggins, Liechti and Roubik, 1976; Brown and Huggins, 1977; Slater, 1980). Dr. Prophet and Dr. Ransom of Emporia State University's Division of Biological Sciences also have sampled in this area, and their collections were made available for analysis.

The main objective of this study was to determine the elmid species composition in the streams of the Cottonwood-Neosho River drainage near Emporia, Kansas. A secondary objective was to record observations concerning the general ecology of elmid beetles in this area.

DESCRIPTION OF THE STUDY AREA

The study area encompassed the Neosho and Cottonwood Rivers and their tributaries between Elmdale and Council Grove to the west and Leroy to the east (Figure 1). The western edge of the study area lies in the Flint Hills, and to the east it extends onto the Osage Cuestas. The vegetation associated with the streams within the area also makes a transition from west to east. In the Flint Hills, the tallgrass prairie composed of big bluestem, little bluestem, Indian grass, and switch grass dominates the vegetation along the streams. But as one moves east, more woody vegetation becomes evident, with the predominant species being cottonwood, hackberry, oak, elm, and sycamore.

The gradient of the Neosho River channel from Council Grove to Emporia is about three feet per mile. The Cottonwood River from Durham to its mouth has a slope of two feet per mile. From the confluence of the two rivers to John Redmond Reservoir, the gradient decreases to 1.35 feet per mile. The bedrock of the two rivers is mostly limestone and is exposed mainly in the riffle areas, whereas the bedrock is overladen with silt in the slower parts of the river (Division of Water Resources, 1947). The flow of the Neosho and Cottonwood Rivers above Emporia is directly related to releases from Council Grove Reservoir and Marion Reservoir, respectively; John Redmond Reservoir controls the flow of the Neosho River downstream from Burlington. Figure 2 illustrates the inflow and outflow of water at John Redmond Reservoir during 1978 and 1979. Since releases from John Redmond Reservoir directly affect flow in the Neosho River below the reservoir, one can see how quickly the water levels in the river change.

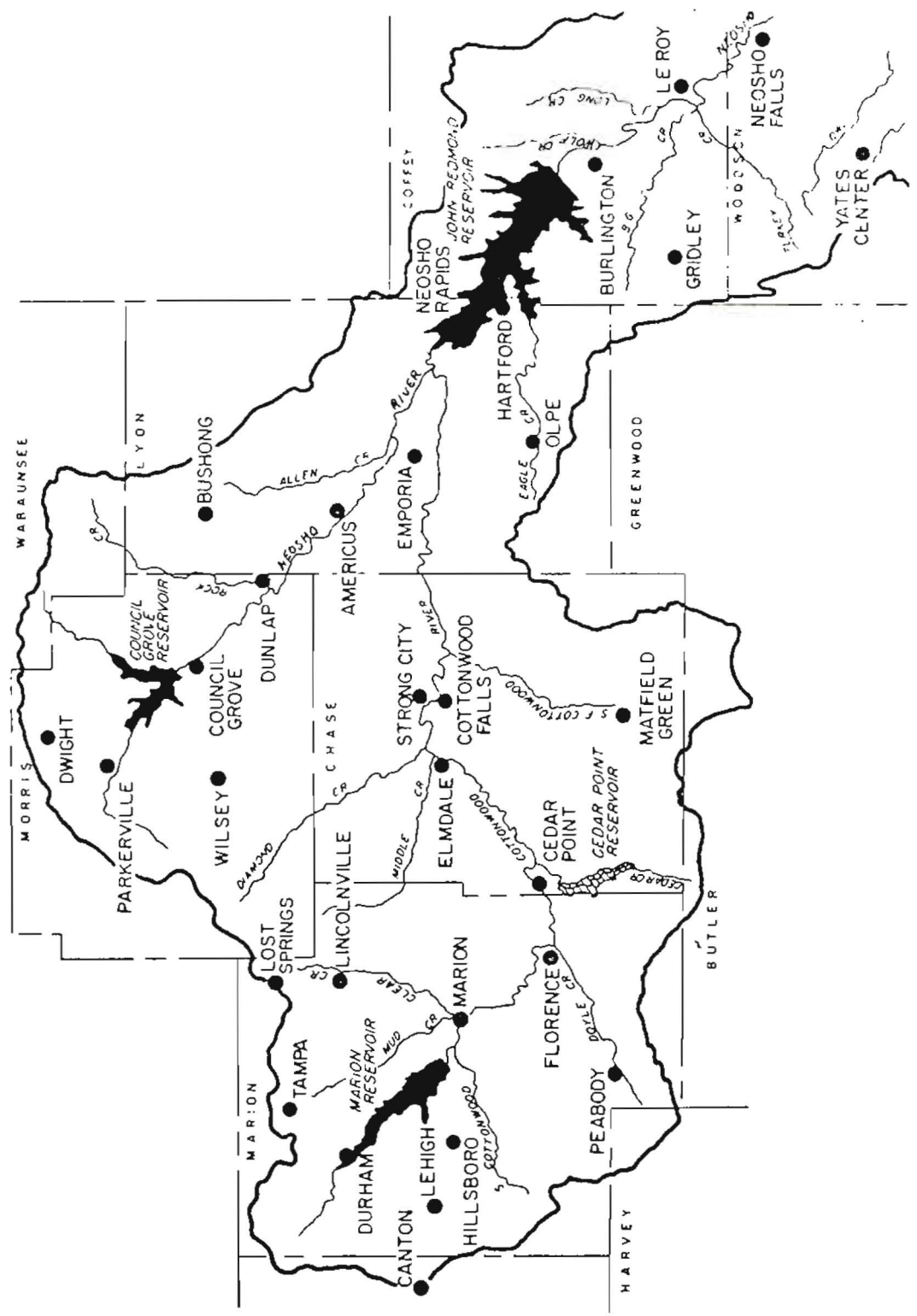


Figure 1. Map of the Cottonwood-Neosho River drainage including the area sampled during this study.

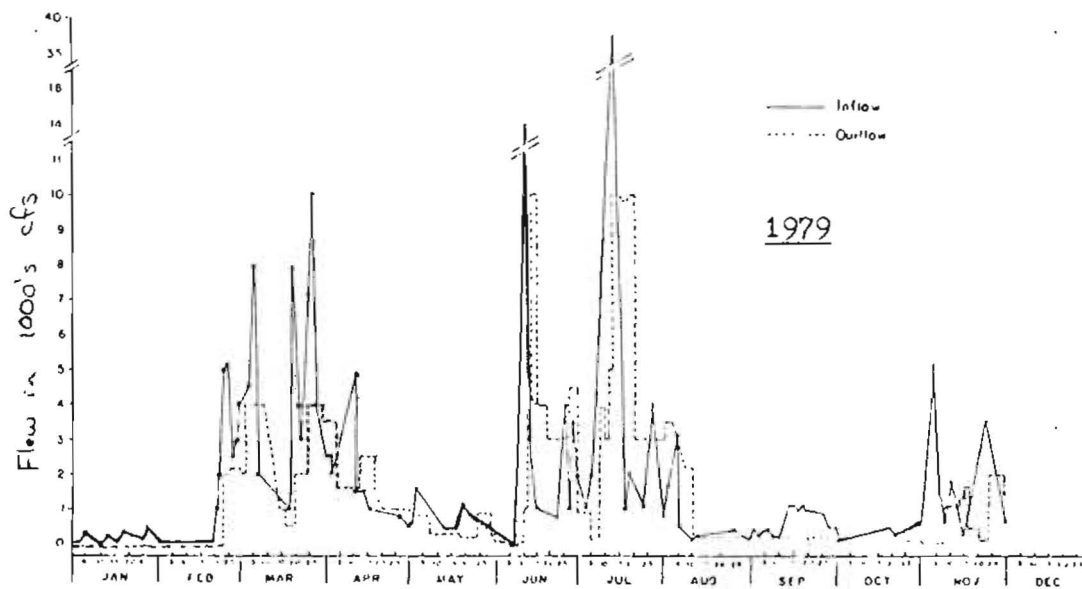
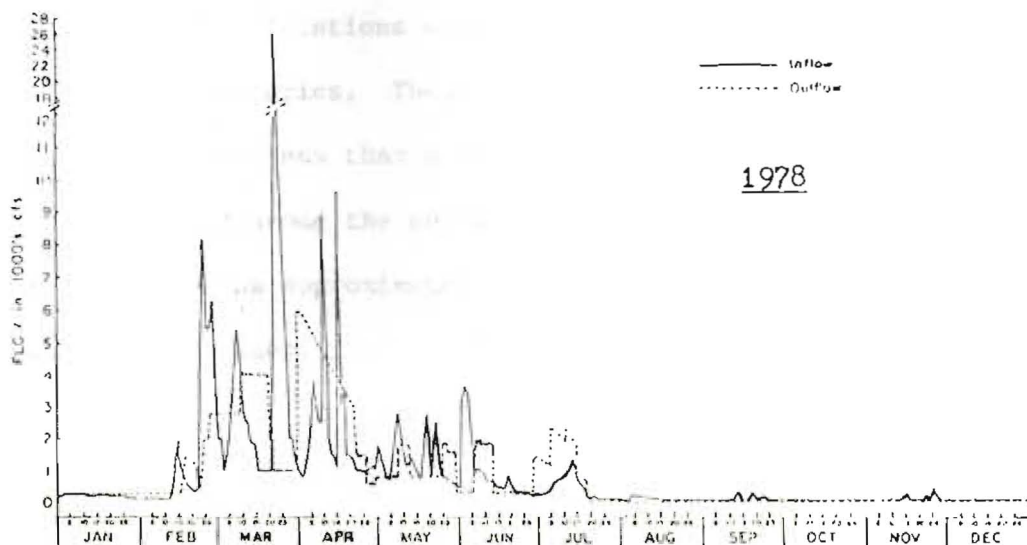


Figure 2. Inflow and outflow records of John Redmond Reservoir during 1978 and 1979 (from U. S. Army Corps of Engineers, 1978, 1979).

All collection locations were located on riffles in either the rivers or the tributaries. These riffles ranged in size from about 30 meters in length to less than a meter in length. The depth of the riffle also varied among the collection locations, with the deepest riffle sampled being approximately 50 cm deep and the most shallow riffle being 2 cm deep.

METHODS AND MATERIALS

During this study, as many flowing streams as possible were visited within the study area to obtain samples. In all, 39 stream locations were sampled. In addition, samples were analyzed from eight locations on the Whitewater River in Butler County. Not all 39 locations were sampled by the author; for example, several collections taken by Dr. Carl Prophet from the drainage of Diamond Creek in Chase County during 1979-1980 were made available for analysis. Additional samples collected in 1973 from the Cedar Creek drainage in Chase County by Dr. Prophet and Dr. Ransom also were made available for examination but were not included in the total of 39 collection locations. Hazleton Environmental Sciences from Lincoln, Nebraska, supplied elmids larval specimens for examination which were collected below John Redmond Reservoir on the Neosho River and Wolf Creek, which is a tributary of the Neosho River.

Three different types of sampling equipment were used to collect elmids during this study. They included the Ponar dredge, the Surber sampler, and handpicking. Of these three methods, handpicking was the most widely used. The Ponar dredge was used exclusively by Hazleton. Their collection locations were predetermined before the start of this study and so they did not specifically sample the riffle habitats. The Surber sampler was used by Prophet, Ransom, and the author. The handpicking method was used by both Prophet and the author.

In this study, handpicking was accomplished by moving upstream in a riffle, picking up rocks, turning them over, and removing any adult or larval elmids with a pair of forceps, and placing them in 90% alcohol.

The time spent at each riffle depended on the size of the riffle. A small riffle with only a few rocks could be entirely picked in ten minutes, whereas, the larger riffles required 20 to 30 minutes, or longer, to get an adequate representation of the elmids population inhabiting that riffle. Due to the nature of handpicking, most water deeper than one meter was not sampled. Adult elmids were easier to locate if they were moving about, and it seemed they moved about more after the rock was picked up, turned over, and the water was allowed to drain off the rock.

Most elmids are covered with a thick coat of encrustations, and so cannot be identified in the field. Specimens collected in this study were transported to the laboratory and stored in 90% alcohol. In the laboratory, a small gauge needle was used to scrape off the encrusting material. Brown (1972) suggested that a small camel hair brush that had been clipped short could be used as well, but this technique would only be useful on a small amount of encrustations. The adult elmids were held with a pair of forceps in one hand and the encrustations were scraped off with the hypodermic needle which was held in the other hand. The elmids should be placed underwater when doing this because the encrustations are removed easier and the vittae on the elytra become more distinct than when they are dry. If adult males have been collected, the aedeagus (elmids male genitalia) must be removed for positive identification. The hypodermic needle was very useful in the removal of the aedeagus. The taxonomically important median lobe of the aedeagus was most easily observed when the aedeagus was placed in mounting medium on a slide with a coverslip over it. Positive identification was determined using a

binocular dissecting microscope.

Records of the elmids species found in this study were sent to the State Biological Survey in Lawrence, Kansas. A separate reference collection of all the elmids species which were collected during this study was placed with the Division of Biological Sciences at Emporia State University. Verification of some elmids specimens was performed by Dr. Harley P. Brown of the University of Oklahoma and by Alex Slater of the Kansas State Biological Survey.

RESULTS AND DISCUSSION

Field collections were begun in August, 1978, and were continued at intervals until July, 1980. Table 1 geographically identifies the 39 different stream sites from which specimens used during this study were collected. These 39 stream sites were located in 23 different streams plus the Cottonwood and Neosho Rivers in Morris, Chase, Greenwood, Lyon, and Coffey Counties.

The State Biological Survey began compiling a list of the elmid species occurring in Kansas in 1975, and their current species list contains nine elmid species which have been collected in the study area. Table 2 lists the elmid species collected by the State Biological Survey in the study area and the species collected in the study area by the author. The two species not collected by the author but reported by the State Biological Survey as inhabiting the study area, were Dubiraphia vittata and D. minima. Prophet collected D. vittata on the Cedar Creek drainage in Chase County in 1973. Table 3 lists each elmid species identified during this study and the locations where each species was collected. The following is an annotated list of the elmid species collected during this study.

Species Collected

Dubiraphia vittata (Melsheimer, 1844).

This species is found throughout the eastern and central states westward to New Mexico, Utah, and Idaho (Brown, 1972). In Figure 3, one can see that this species is found scattered through the eastern two-third of Kansas (Huggins et al. 1976; Brown and Huggins, 1977; Slater, 1980). Huggins et al. (1976) reported D. vittata from Chase County, and

Table 1. The geographic locations of all collection sites sampled during this study.

Site No.	Location
1	Cottonwood River, Chase County, S27, T19S, R8E.
2	Cottonwood River, Chase County, S29, T19S, R8E.
3	Cottonwood River, Lyon County, S28, T19S, R12E.
4	Cottonwood River, Lyon County, S15, T19S, R10E.
5	Cottonwood River, Lyon County, S22, T19S, R11E.
6	South Fork of the Cottonwood, Chase County, S5, T22S, R8E.
7	South Fork of the Cottonwood, Chase County, S27, T20S, R8E.
8	Rock Creek, Chase County, S32, T20S, R8E.
9	Buck Creek, Chase County, S5, T20S, R8E.
10	Middle Creek, Chase County, S16, T18S, R6E.
11	Jacob's Creek, Chase County, S12, T20S, R9E.
12	Stout Run Creek, Chase County, S11, T19S, R8E.
13	Peyton Creek, Chase County, S20, T19S, R9E.
14	Diamond Creek, Chase County, S15, T19S, R7E.
15	Diamond Creek, Chase County, S16, T19S, R5E.
16	Diamond Creek, Morris County, S16, T19S, R6E.
17	Unnamed tributary to Diamond Creek, Chase County, S29, T18S, R6E.
18	Unnamed tributary to Diamond Creek, Chase County, S31, T19S, R8E.
19	Unnamed tributary to Diamond Creek, Chase County, S4, T18S, R6E and S9, T18S, R6E.
20	Unnamed tributary to Diamond Creek, Chase County, S27, T19S, R7E.
21	Unnamed tributary to Diamond Creek, Chase County, S12, T18S, R6E.
22	Unnamed tributary to Diamond Creek, Chase County, S8, T18S, R6E.
23	Unnamed tributary to Diamond Creek, Morris County, S4, T18S, R6E and S9, T18S, R6E.
24	Unnamed tributary to Diamond Creek, Morris County, S9, T18S, R6E.
25	Unnamed tributary to Diamond Creek, Morris County, S19, T18S, R6E.
26	Neosho River, Morris County, S31, T16S, R9E.
27	Neosho River, Lyon County, S9, T18S, R10E.
28	Neosho River, Lyon County, S2, T19S, R11E.
29	Neosho River, Lyon County, S7, T19S, R12E.
30	Neosho River, Lyon County, S15, T20S, R13E.
31	Neosho River, Coffey County, S10, T21S, R15E.
32	Neosho River, Coffey County, S12, T22S, R15E.
33	Neosho River, Coffey County, S7, T22S, R16E.
34	Unnamed tributary of the Neosho River, Lyon County, S17, T18S, R10E.
35	Dow Creek, Lyon County, S23, T18S, R11E.

Table 1. The geographic locations of all collection sites sampled during this study. (Continued)

Site No.	Location
36	Long Creek, Coffey County, S28, T20S, R16E.
37	Wolf Creek, Coffey County, S31, T21S, R16E.
38	Indian Creek, Morris County, S33, T17S, R9E.
39	Big Springs, Greenwood County, S12, T23S, R8E.

Table 2. Elmid species collected by the State Biological Survey and the author in the study area.

Elmid Species	1*	2*
<u>Dubiraphia vittata</u>	X	
<u>Dubiraphia minima</u>	X	
<u>Macronychus glabratus</u>	X	X
<u>Microcylloepus pusillus</u>	X	X
<u>Stenelmis bicarinata</u>	X	X
<u>Stenelmis crenata</u>	X	X
<u>Stenelmis decorata</u>	X	X
<u>Stenelmis sexlineata</u>	X	X
<u>Stenelmis vittipennis</u>	X	X
<u>Stenelmis</u> sp.		X

* Column 1 designates the species collected by the State Biological Survey in the study area. Column 2 designates the species collected by the author.

Table 3. Sample locations of elmid species collected during this study.

<u>Stenelmis bicarinata</u>	<ul style="list-style-type: none"> - Cottonwood River, Chase County, S27, T19S, R8E. - Cottonwood River, Lyon County, S15, T19S, R10E. - Cottonwood River, Lyon County, S28, T19S, R12E. - Cottonwood River, Lyon County, S22, T19S, R11E. - Jacob's Creek, Chase County, S12, T20S, R9E. - South Fork of the Cottonwood, Chase County, S27, T20S, R8E. - South Fork of the Cottonwood, Chase County, S5, T22S, R8E. - Rock Creek, Chase County, S32, T20S, R8E. - Diamond Creek, Chase County, S16, T19S, R5E. - Stout Run Creek, Chase County, S11, T19S, R8E. - Neosho River, Morris County, S31, T16S, R9E. - Neosho River, Lyon County, S9, T18S, R10E. - Neosho River, Lyon County, S2, T19S, R11E. - Neosho River, Lyon County, S7, T19S, R12E. - Neosho River, Lyon County, S15, T20S, R13E. - Neosho River, Coffey County, S10, T21S, R15E.
<u>Stenelmis crenata</u>	<ul style="list-style-type: none"> - Stout Run Creek, Chase County, S11, T19S, R8E. - Diamond Creek, Chase County, S16, T19S, R5E. - Unnamed tributary of Diamond Creek, Chase County, S12, T18S, R6E. - Unnamed tributary of Diamond Creek, Chase County, S4, T18S, R6E and S9, T18S, R6E. - Unnamed tributary of Diamond Creek, Chase County, S31, T19S, R8E. - Neosho River, Lyon County, S9, T18S, R10E. - Neosho River, Coffey County, S10, T21S, R15E.
<u>Stenelmis decorata</u>	<ul style="list-style-type: none"> - Cottonwood River, Chase County, S27, T19S, R8E. - Unnamed tributary of Diamond Creek, Chase County, S8, T18S, R6E. - Neosho River, Morris County, S31, T16S, R9E. - Neosho River, Coffey County, S10, T21S, R15E.

Table 3. Sample locations of elmid species collected during this study.
(Continued)

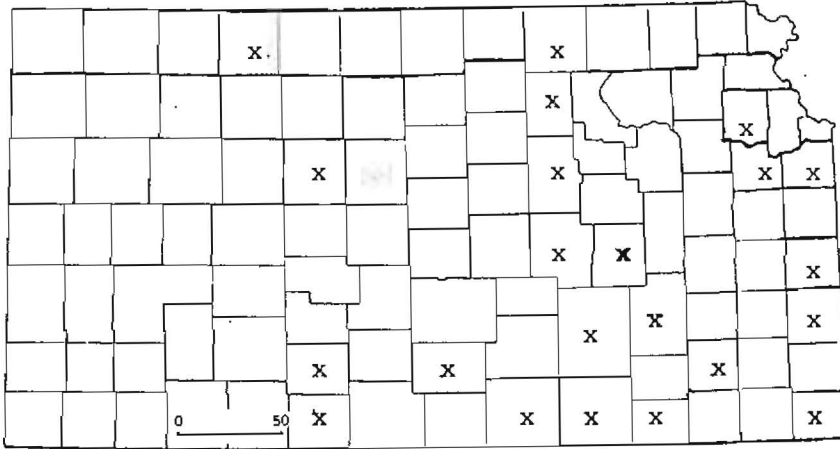
<u>Stenelmis sexlineata</u>	<ul style="list-style-type: none"> - Cottonwood River, Chase County, S27, T19S, R8E. Cottonwood River, Lyon County, S15, T19S, R10E. Buck Creek, Chase County, S5, T20S, R8E. Rock Creek, Chase County, S32, T20S, R8E. South Fork of the Cottonwood, Chase County, S5, T22S, R8E. Peyton Creek, Chase County, S20, T19S, R9E. Stout Run Creek, Chase County, S11, T19S, R8E. Middle Creek, Chase County, S16, T18S, R6E. Unnamed tributary of Diamond Creek, Chase County, S31, T19S, R8E. Unnamed tributary of Diamond Creek, Chase County, S8, T18S, R6E. Unnamed tributary of Diamond Creek, Chase County, S4, T18S, R6E and S9, T18S, R6E. Neosho River, Morris County, S31, T16S, R9E. Neosho River, Lyon County, S9, T18S, R10E. Indian Creek, Chase County, S33, T17S, R9E. Unnamed tributary of the Neosho River, Lyon County, S17, T18S, R10E. Dow Creek, Lyon County, S23, T18S, R11E. Long Creek, Coffey County, S28, T20S, R16E. Big Springs, Greenwood County, S12, T23S, R8E.
<u>Stenelmis vittipennis</u>	<ul style="list-style-type: none"> - Cottonwood River, Chase County, S27, T19S, R8E. Cottonwood River, Lyon County, S28, T19S, R11E. Cottonwood River, Lyon County, S15, T19S, R10E. South Fork of the Cottonwood, Chase County, S27, T20S, R8E. Jacob's Creek, Chase County, S12, T20S, R9E. Buck Creek, Chase County, S5, T20S, R8E. Neosho River, Morris County, S31, T16S, R9E. Neosho River, Lyon County, S9, T18S, R10E. Neosho River, Lyon County, S7, T19S, R12E. Neosho River, Lyon County, S15, T20S, R13E. Neosho River, Coffey County, S10, T21S, R15E.

Table 3. Sample locations of elmid species collected during this study.
(Continued)

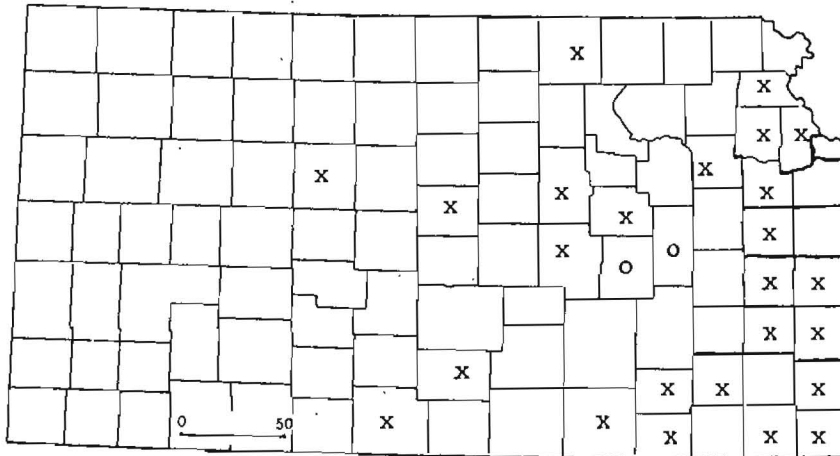
<u>Stenelmis</u> sp.	<ul style="list-style-type: none"> - Cottonwood River, Lyon County, S22, T19S, R11E. South Fork of the Cottonwood, Chase County, S5, T22S, R8E. Peyton Creek, Chase County, S20, T19S, R9E. Unnamed tributary of Diamond Creek, Chase County, S4, T18S, R6E and S9, T18S, R6E. Unnamed tributary of the Neosho River, Lyon County, S17, T18S, R10E.
<u>Macronychus glabratus</u>	<ul style="list-style-type: none"> - Unnamed tributary of Diamond Creek, Morris County, S19, T18S, R6E. Unnamed tributary of Diamond Creek, Morris County, S9, T18S, R6E. Diamond Creek, Chase County, S15, T19S, R7E. Neosho River, Lyon County, S2, T19S, R11E.
<u>Microcylloepus pusillus</u>	<ul style="list-style-type: none"> - Cottonwood River, Chase County, S27, T19S, R8E. Cottonwood River, Lyon County, S15, T19S, R10E. South Fork of the Cottonwood, Chase County, S5, T22S, R8E. Diamond Creek, Chase County, S15, T19S, R7E.

Table 3. Sample locations of elmids species collected during this study.
(Continued)

<u>Stenelmis</u> sp.	- Cottonwood River, Lyon County, S22, T19S, R11E. South Fork of the Cottonwood, Chase County, S5, T22S, R8E. Peyton Creek, Chase County, S20, T19S, R9E. Unnamed tributary of Diamond Creek, Chase County, S4, T18S, R6E and S9, T18S, R6E. Unnamed tributary of the Neosho River, Lyon County, S17, T18S, R10E.
<u>Macronychus glabratus</u>	- Unnamed tributary of Diamond Creek, Morris County, S19, T18S, R6E. Unnamed tributary of Diamond Creek, Morris County, S9, T18S, R6E. Diamond Creek, Chase County, S15, T19S, R7E. Neosho River, Lyon County, S2, T19S, R11E.
<u>Microcylloepus pusillus</u>	- Cottonwood River, Chase County, S27, T19S, R8E. Cottonwood River, Lyon County, S15, T19S, R10E. South Fork of the Cottonwood, Chase County, S5, T22S, R8E. Diamond Creek, Chase County, S15, T19S, R7E.



Dubiraphia vittata (Melsheimer 1844)



Macronychus glabratus Say 1825

x - collected by the State Biological Survey.

o - collected by the State Biological Survey and the author.

Figure 3. Distribution of D. vittata and Macronychus glabratus in Kansas.

this is the only county in the study area in which this species has been collected. Adult and larval Dubiraphia were collected by Prophet from Middle Creek of the Cedar Creek drainage in Chase County in 1973, and Ransom collected D. vittata at two of eight sampling locations in July 1978 on the Whitewater River in Butler County.

This species is one of the smallest elmids reported in this area. It ranges from 1.8 mm to 2.5 mm in length (Brown, 1972). The other Dubiraphia species, D. minima, is about the same size, so positive identification can only be made after examination of the male aedeagus.

Macronychus glabratus Say 1825.

This is the only species of this genus in the United States. Brown (1972) reported that this species is found in the eastern and central states from Florida to Maine and eastern Texas and Oklahoma to Wisconsin. In Figure 3, one can see that this species is found in the eastern third of Kansas and as far west as Ellis County (Huggins et al, 1976; Brown and Huggins, 1977; Slater, 1980). In the study area, M. glabratus was collected at four of the 39 collection locations. Three of the locations were in Chase County, and the fourth was on the Neosho River north of Emporia. This species was not found by either Prophet on the Cedar Creek drainage or Ransom on the Whitewater River.

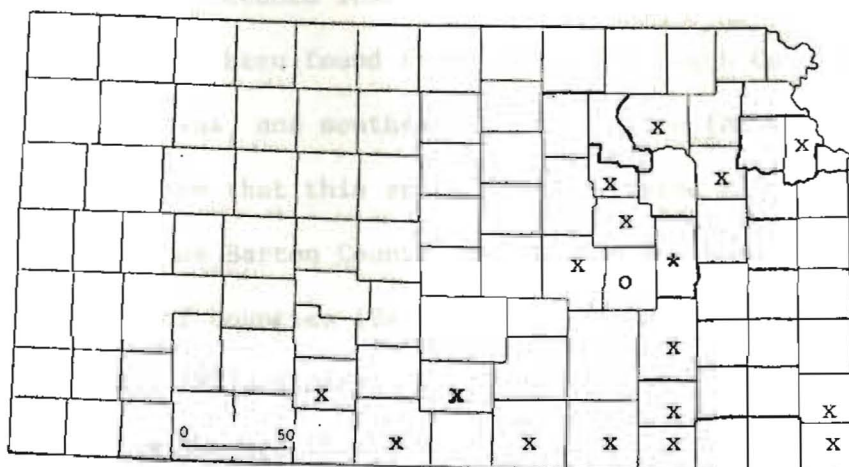
This species is an easy elmid to identify in the field. It has a jet black elytra which forms a small ridge down the middle. Its long legs and relatively small body give M. glabratus a spidery appearance, especially when it is suspended in water.

Microcylloepus pusillus (LeConte 1852).

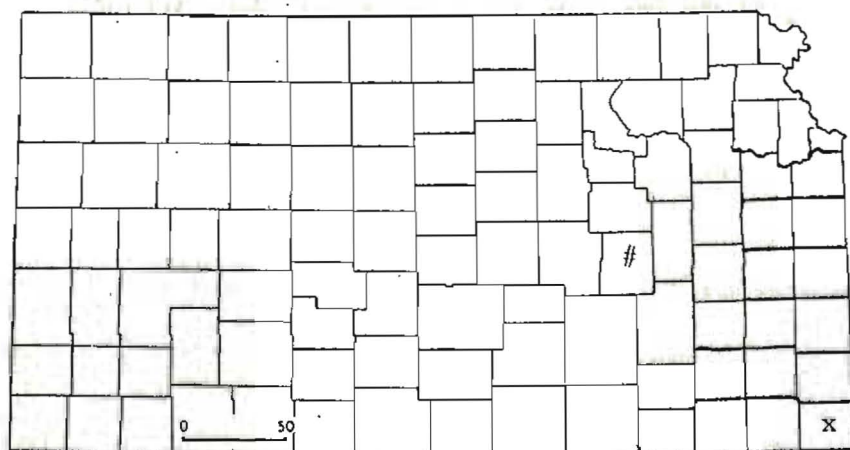
This species is found from Mexico east to Florida, west to California, and north to Oregon, Idaho, Wyoming, South Dakota, Missouri, Kansas, Tennessee, and among the eastern states to Maine (Brown, 1972). Huggins et al. (1976), Brown and Huggins (1977), and Slater (1980) reported that this species occurs in Kansas in the Flint Hills from Pottawatomie County to Chautauqua County, and that it also is found along the southern tier of counties as far west as Kiowa County (Figure 4). During this study, M. pusillus was found at four of the 39 collection locations. Three locations were in Chase County, one on Diamond Creek, one on the Cottonwood River east of Cottonwood Falls, and one on the South Fork of the Cottonwood. The fourth location was on the Cottonwood River in Lyon County. Prophet (personal communication) reported this species from Middle Creek in the Cedar Creek drainage in Chase County, and Ransom collected it at two of his sampling locations in Butler County.

Stenelmis beameri Sanderson 1938.

Brown (1972) reported that this species is found in Arkansas, Missouri, Oklahoma, and Tennessee. In Figure 4, one can see that it has been reported only from Cherokee County in Kansas (Brown and Huggins, 1977). The only specimen of S. beameri found in the study area was collected by Prophet in 1973 from Middle Creek on the Cedar Creek drainage in Chase County. This collection represents the northernmost record of S. beameri in Kansas. Ransom did not collect this species in Butler County in 1978.



Microcyloepus pusillus (LeConte 1852)



Stenelmis beameri Sanderson 1938

- x - collected by the State Biological Survey.
- o - collected by the State Biological Survey and the author.
- * - collected by the author only.
- # - collected by Dr. Carl Prophet in 1973.

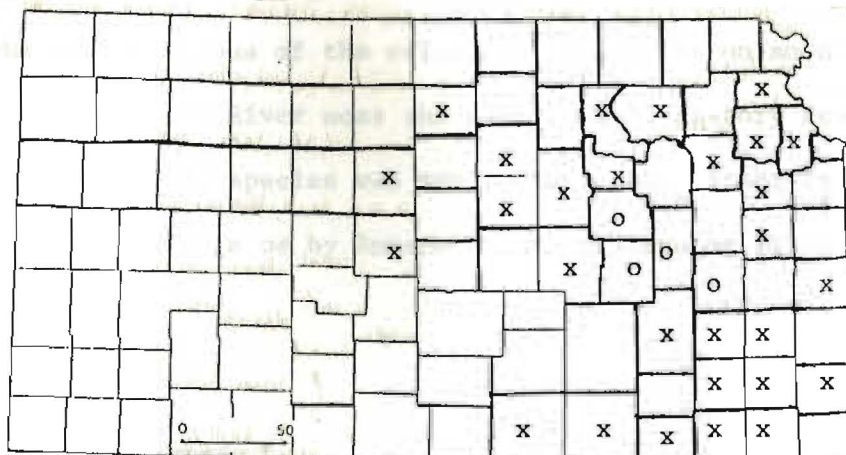
Figure 4. Distribution of Microcyloepus pusillus and S. beameri in Kansas.

Stenelmis bicarinata LeConte 1852.

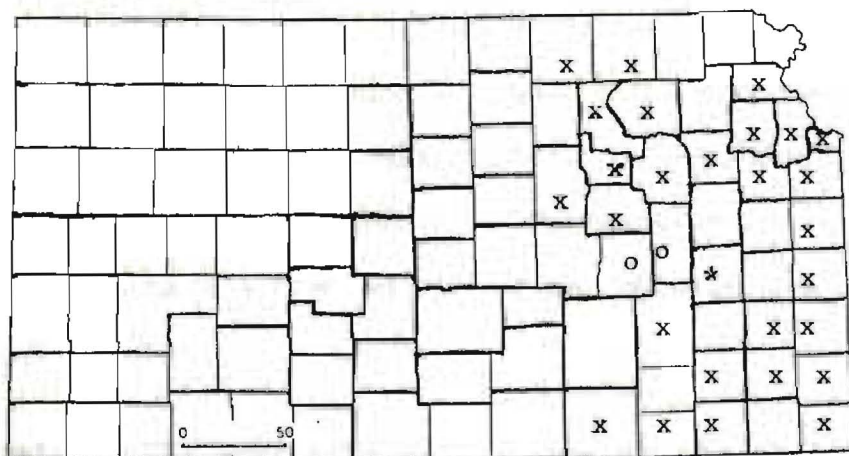
This species has been found from Vermont to South Carolina, west to Wisconsin and Texas, and southeastern New Mexico (Brown, 1972). In Figure 5, one can see that this species is scattered through eastern Kansas as far west as Barton County, but it has not been reported from the northern tier of counties (Sanderson, 1938; Huggins et al. 1976; Brown and Huggins, 1977; Slater, 1980). In the study area, this species was collected from Morris, Chase, Lyon, and Coffey Counties. Stenelmis bicarinata was collected at 16 of the 39 collection locations. Although this species was collected from the tributaries as well as the main rivers, it was found in greater numbers in the rivers than in the tributaries. This species also was reported by Prophet from Middle Creek in the Cedar Creek drainage in Chase County, but none was collected by Ransom in his collections on the Whitewater River.

Stenelmis crenata (Say 1824).

This species has been found from Alabama and northwestern Florida northeastward to New Brunswick and westward to Texas, Kansas, and Wisconsin (Brown, 1972). In Figure 5, one can see that this species is found in the eastern third of Kansas, with Dickinson County being its westernmost boundary (Sanderson, 1938; Huggins et al. 1976; Brown and Huggins, 1977; Slater, 1980). In the study area, S. crenata was found at seven of the 39 collection locations. Five of the seven locations were in Chase County, and all were on tributaries of the Cottonwood River. Both of the other two locations were on the Neosho River, one in Lyon County and the other in Coffey County. The only location where S. crenata



Stenelmis bicarinata (LeConte 1852)



Stenelmis crenata (Say 1824)

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- o - collected by the State Biological Survey and the author.
- * - collected by the author only.

Figure 5. Distribution of S. bicarinata and S. crenata in Kansas.

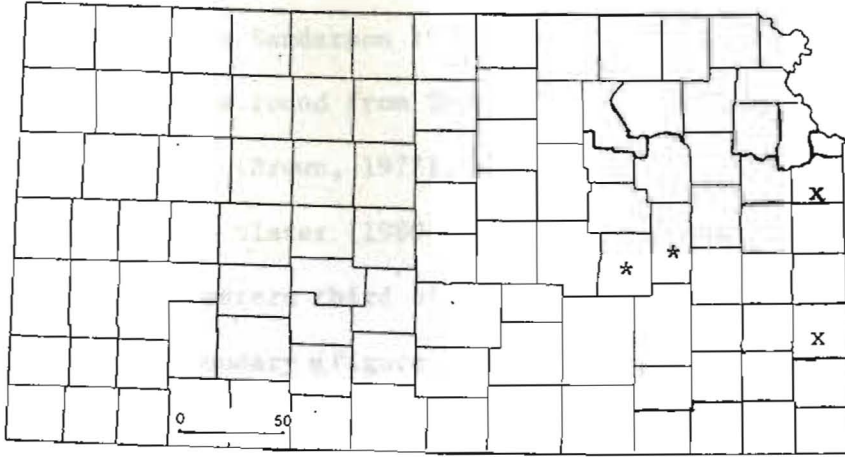
was the most numerous of the collected elmids was on an unnamed tributary of the Neosho River near the Ross Natural History Reservation west of Americus. This species was not collected by either Prophet on the Cedar Creek drainage or by Ransom on the Whitewater River in Butler County.

Stenelmis sp.

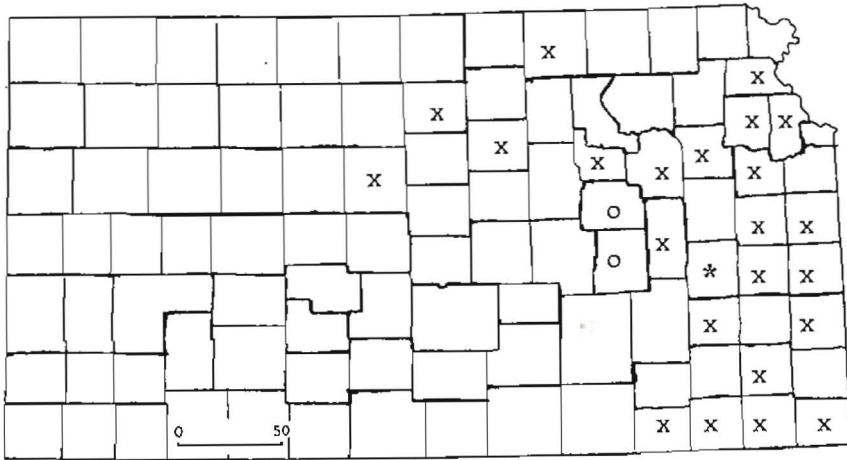
Alex Slater (personal communication) of the State Biological Survey believes there are two species of elmids which key to S. crenata based on Brown (1972). This new species is referred to by Slater as Stenelmis species near crenata, but the author will refer to it as Stenelmis sp. Externally, Stenelmis sp. is identical to S. crenata, but the aedeagus of this new species lacks the lateral processes on the median lobe which are characteristic of S. crenata. Brown (1972) did not mention this new species in his United States distributional records, but Slater (1980) reported this species from Johnson and Bourbon Counties in Kansas (Figure 6). Stenelmis sp. was found at five of the 39 collection locations in Chase and Lyon Counties.

Stenelmis decorata Sanderson 1938.

Brown (1972) reported that this species is found from South Carolina to Maryland and west to Kansas and Wisconsin. In Figure 6, one can see that S. decorata is distributed through the eastern third of Kansas and also in the three north-central counties of Russell, Mitchell, and Ottawa (Huggins et al. 1976; Brown and Huggins, 1977; Slater, 1980). In the study area, this species was found at four of the 39 collection locations. One location was a new county record for Coffey County. Neither Prophet nor Ransom reported S. decorata in their collections.



Stenelmis sp.



Stenelmis decorata Sanderson 1938

x - collected by the State Biological Survey.

o - collected by the State Biological Survey and
the author.

* - collected by the author only.

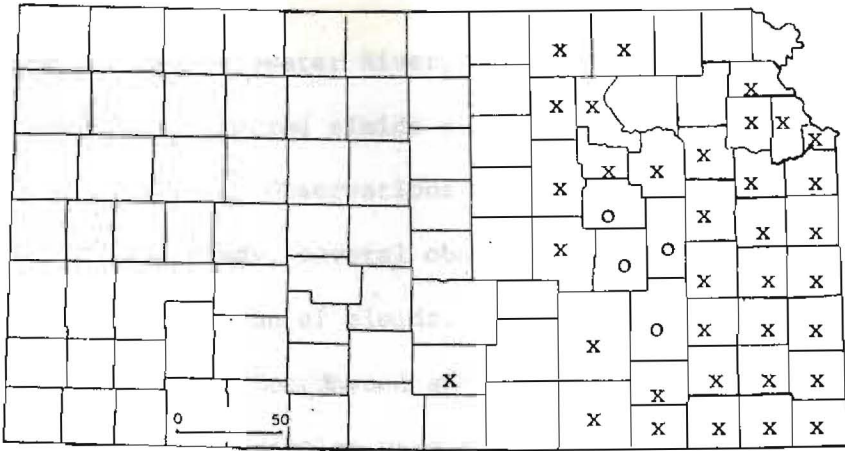
Figure 6. Distribution of Stenelmis sp. and S. decorata in Kansas.

Stenelmis sexlineata Sanderson 1938.

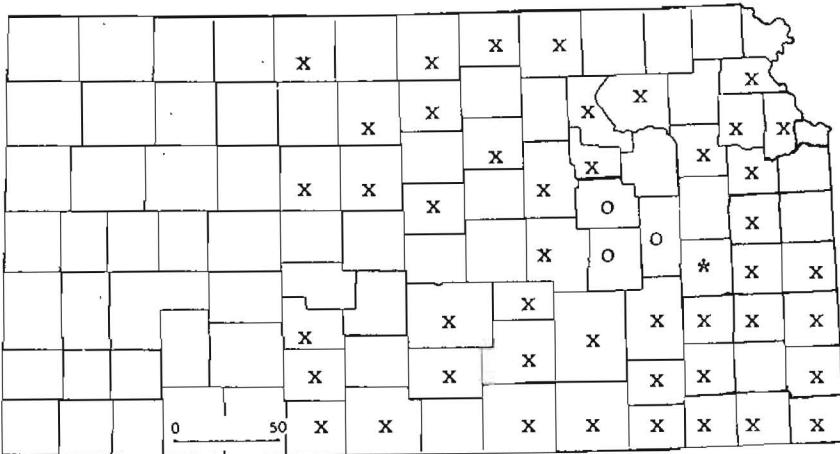
This species is found from Tennessee and Kentucky to Indiana, Kansas, Oklahoma, and Texas (Brown, 1972). Huggins et al. (1976), Brown and Huggins (1977), and Slater (1980) reported that this species is found primarily in the eastern third of the state with the Flint Hills being its westernmost boundary (Figure 7). However, there is one record of it in Kingman County. This distinctive species, with its six-striped elytra, was found at 18 of the 39 collection locations in the study area. Generally, this species was the most numerous of all the collected elmids species in the tributaries. During this study, S. sexlineata was collected in Chase, Morris, Lyon, Coffey, and Greenwood Counties. It was collected by Prophet on Middle Creek in the Cedar Creek drainage in Chase County, and by Ransom at four of his sampling locations on the Whitewater River in Butler County.

Stenelmis vittipennis Zimmerman 1869.

This species has been reported from Quebec to South Carolina and west to North Dakota and Kansas (Brown, 1972). In Figure 7, one can see that this species is found in the eastern two-thirds of the state, no farther west than Comanche and Phillips Counties (Sanderson, 1938; Huggins et al. 1976; Brown and Huggins, 1977; Slater, 1980). Stenelmis vittipennis was found at 11 of the 39 collection locations in Chase, Morris, Lyon, and Coffey Counties. This species had not been previously reported by the State Biological Survey as occurring in Coffey County. It should have been expected to occur here because this species is present in counties upstream and downstream from Coffey County. Prophet did not collect this species from Middle Creek in the Cedar Creek drainage. Ransom collected it at eight



Stenelmis sexlineata Sanderson 1938



Stenelmis vittipennis Zimmerman 1869

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- o - collected by the State Biological Survey and the author.
- * - collected by the author only.

Figure 7. Distribution of *S. vittipennis* and *S. sexlineata* in Kansas.

locations on the Whitewater River, and it comprised about 80% of the total number of collected elmids during his study.

Observations on Elmid Ecology

During this study, several observations were made concerning the population distribution of elmids. Initially, seven sampling stations were selected on the Cottonwood and Neosho Rivers. At each of these locations two Surber samples were taken within about thirty cm of each other. When examined in the laboratory, wide variations in the numbers of adults and larvae were found between the two samples collected at each location. These preliminary inspections suggested that elmids demonstrated a clumped type of distribution.

At one location on the Cottonwood River, one mile east of Cottonwood Falls, 14 Surber samples were collected on a large riffle. After examination, the clumped distribution pattern was evident again. These samples were taken in two parts; the first part was from the top layer of rocks, usually about three centimeters deep, while the second part was taken from the next eight to ten centimeters. There were differences in relative abundance of elmids between the two strata at some of the locations, but no specific pattern emerged as to preference for either the top or bottom stratum.

Stenelmis bicarinata, S. vittipennis, and S. sexlineata were usually the most commonly collected species of elmids during this study. The most obvious exceptions to this pattern were M. pusillus, which was abundant on the South Fork of the Cottonwood east of Matfield Green (Site #6), and S. crenata, which was the most abundant species collected from a small unnamed stream located approximately 0.25 mile east of the Ross Natural History Reservation (Site #34).

Although no single species appeared to be restricted to either the main stream or the tributaries, there were apparent differences in habitat preferences of the three most commonly collected species. Figure 8 compares the relative abundances of these three species at the Cottonwood River sites to their relative abundances in the tributaries. One can see in Figure 8 that S. vittipennis composed about the same percentage of the total specimens collected in both the tributaries and the river. However, S. bicarinata and S. sexlineata demonstrated major differences between their percentages in the tributaries and the river. In the Cottonwood River S. bicarinata comprised over 75% of all specimens collected, and S. sexlineata constituted only 3% of the specimens. In the tributaries of the Cottonwood River S. bicarinata contributed 29% of the total number of collected elmids, compared to 32% for S. sexlineata. Although this predominance of S. sexlineata in the tributaries and S. bicarinata in the river was consistent within the Cottonwood River study area, this pattern was not repeated in the Whitewater River drainage. Ransom (personal communication) found that S. vittipennis was the most common elmids collected from that drainage during 1978, while S. bicarinata was not collected.

Sinclair (1964) studied the water quality requirements of elmids in Tennessee. He stated that S. sexlineata may be the most pollution-tolerant elmids species in Tennessee. Tributaries would seem to be a harsh environment for elmids to survive due to the usual intermittent nature of their flow. Most of the tributaries within the study area flow only during the spring and early summer. From late summer through the winter, these tributaries are reduced to pools. In the fall, leaves collect in these pools and their decomposition can lead to low dissolved oxygen concentrations,

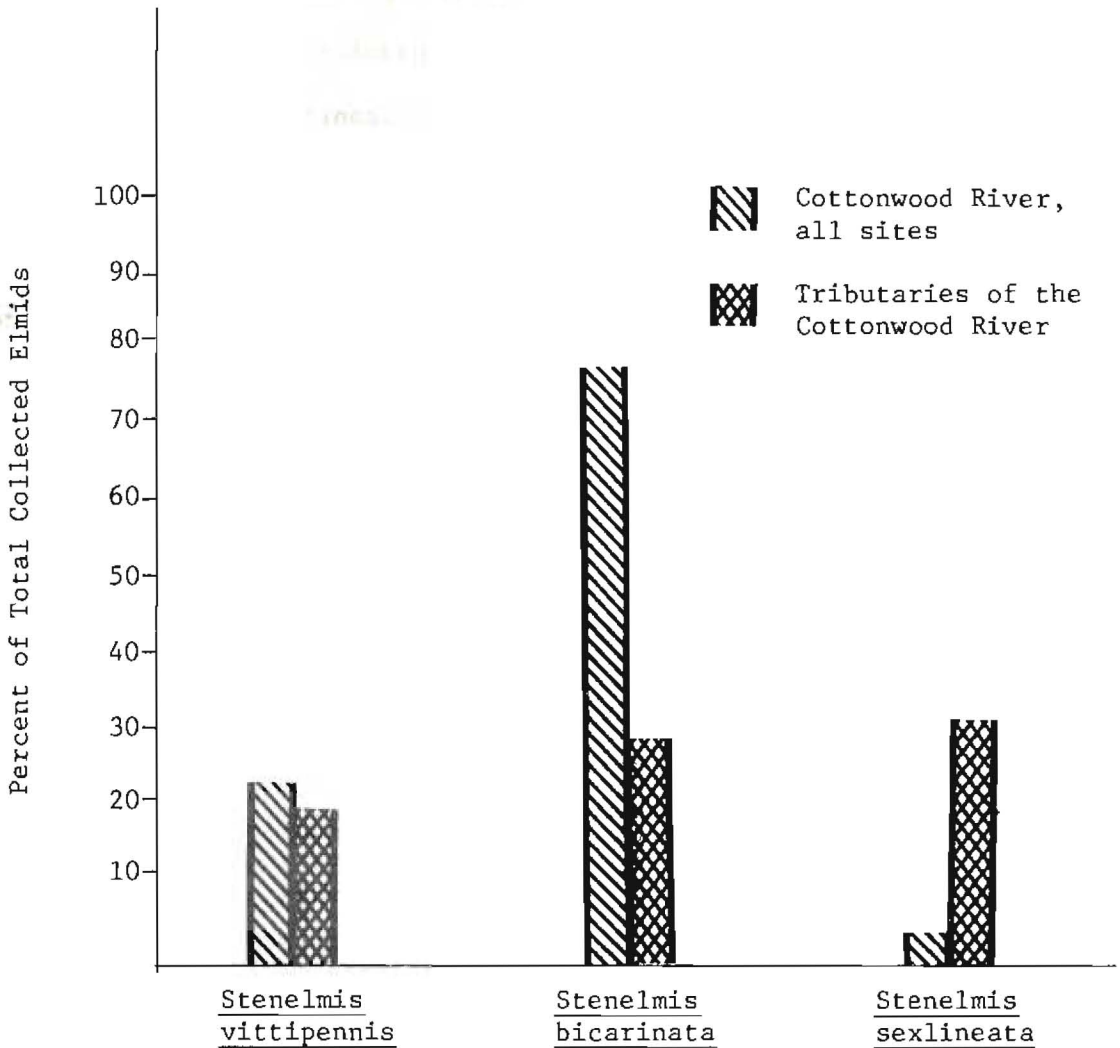


Figure 8. Comparison of relative abundances of S. vittipennis, S. bicarinata and S. sexlineata in the main stream and tributaries of the Cottonwood River.

especially when the pools are ice-covered in the winter. Cattle wastes and farmland runoff also contribute to the environmental stresses in these pools. If S. sexlineata is pollution-tolerant, it would probably tolerate the stressful situations in the tributaries better than other elmids species.

In the river, most of the environmental stresses associated with the tributaries are diluted or non-existent. Thus, the pollution-tolerance of S. sexlineata would have little benefit in terms of survival. The large percentage of S. bicarinata in the river may indicate that it has some competitive advantage over the other elmids species. The exact nature of this advantage is not known. Stenelmis bicarinata and S. sexlineata were found together at the same time and on the same rocks. So this would indicate that they are not separated temporally or spatially. The main difference between the two species is the size of S. sexlineata. This species is the largest elmids found in this area. Its size could play some role in its low abundance in the river, possibly due to less space available per individual. This interspecific competition of these two species needs further study to determine the exact nature of this competition.

SUMMARY

The elmid beetle species composition of the Neosho and Cottonwood Rivers was determined from the fall of 1978 to the summer of 1980. The study area was concentrated on the parts of the Neosho and Cottonwood Rivers and their tributaries which lie in Chase and Lyon Counties. Additional collections were made in Coffey, Morris, and Greenwood Counties.

The State Biological Survey had previously determined that nine elmid species inhabited the study area, but during this study only eight elmid species were collected. One of these eight species, Stenelmis sp., had not been previously collected in the study area. Altogether, there were six new county records established for this area.

The three most common elmid species collected in this area were S. bicarinata, S. vittipennis, and S. sexlineata. Stenelmis bicarinata was collected in greater numbers in the main rivers than in the tributaries. In contrast, S. sexlineata was collected in greater numbers in the tributaries than in the rivers. Stenelmis vittipennis was about equally abundant in both the tributaries and the rivers.

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