UNIONID MUSSELS OF THE
NEOSHO RIVER DRAINAGE

A Thesis

Submitted to

the Division of Biology

Emporia State University, Emporia, Kansas

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

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May, 1977

AN ABSTRACT OF THE THESIS OF

Joe Frazier for the Master of Science Degree

in Biology presented on May, 1977

Title: Unionid Mussels of the Neosho River Drainage

Abstract approved: [signature]

From September, 1975, through October, 1976, unionid mussels from the Neosho River drainage were collected and identified. The results of this study were compared with the work of Murray and Leonard (1962).

Over 2,300 specimens of unionid mussels representing 32 species were collected. Murray and Leonard (1962) reported 37 species in the Neosho River drainage at the time of their study. Of the five species not found in this study, three were assumed to be extinct in Kansas waters since there has been no reports of their occurrence for many years. The other two species are assumed to still exist in the Neosho River drainage but were not found in this study, probably due to inadequate collecting. The range and distribution of several species of unionid mussels were found to differ from that reported by Murray and Leonard.

Water temperature and turbidity data were obtained at each collecting site in this study. Those data were compared to data from the time of the Murray and Leonard (1962) study

when such data could be found. Comparable water temperatures had not differed significantly since the Murray and Leonard study. No turbidity data was available from the Murray and Leonard study and no comparison could be made.

Approved for Major Department

Approved for Graduate Council

ACKNOWLEDGMENT

I would like to express my appreciation to Dr. John Ransom for directing this study and to Drs. Carl Prophet and Thomas Eddy for serving on my committee. Verifications of unionid identifications were made by Dr. Harold Murray of Trinity University and Dr. D. H. Stansbery of Ohio State University. I am particularly grateful to the Division of Biology, Emporia State University, for financial aid in covering expenses incurred during this study.

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INTRODUCTION

Fresh-water mussels belong to the Phylum Mollusca, class Pelecypoda, order Eulamellibranchia, family Unionidae. Murray and Leonard (1962) reported unionids were characterized as follows: shell nacreous having a thick epidermis; beaks usually sculptured, often showing remains of nuclear shell; ligament opisthodetic (behind beak); hinge having or lacking teeth, when teeth are present they are the pseudocardinals and laterals, but never being anterior laterals; pallial line simple. Three subfamilies of unionids are found in the Neosho River drainage; Unioninae, Anodontinae, and Lampsilinae.

Mussels spend their entire life partially or wholly buried in the substrate of streams, ponds, lakes, or any permanent body of water. A mussel generally orientates so that the posterior portion of the shell protrudes from the substrate and is directed upstream. In this way, materials brought in by the ventral incurrent siphon are in part forced into the mantle cavity by the force of the water current, and waste products that are eliminated from the dorsal excurrent siphon are quickly swept away from the animal.

In Kansas there are two primary habitats for fresh-water mussels, impounded water (artificial lakes and ponds) and natural streams. The mussels of Kansas have a high tolerence to siltation but not industrial pollution. Streams in early day Kansas that were relatively clear are now quite turbid and polluted.

Murray and Leonard completed a study in 1962 in which they collected and identified mussels of the Family Unionidae (Mollusca) in Kansas. There has been no significant research or publications dealing with the Kansas unionid mussels since then. Literature of any sort on Kansas unionid mussels was scarce, the work of Murray and Leonard being the most recent and complete. Literature by R. E. Call (1885) and R. E. Scammon (1906) listed some unionid mussels of Kansas. However, many of the mussels listed in their studies have either undergone taxonomic changes, were misidentified, or are no longer present in Kansas waters.

The purpose of this study was to collect, identify and record species of unionid mussels presently occurring in the Neosho River drainage of Kansas, to record their distribution and to compare those findings with that of Murray and Leonard (1962). An additional purpose was to collect water temperature and turbidity data at each collecting site and to compare that data with that of the Murray and Leonard study, if such information could be found.

DESCRIPTION OF THE NEOSHO RIVER DRAINAGE

Schoewe (1949) reported the Neosho River drainage (Fig. 1) to be part of the Kansas central lowlands physiographic area. Starting in the Flint Hills and flowing southeasterly it drains the following Kansas Counties; Marion, Morris, Lyon, Chase, Coffey, Woodson, Allen, Neosho, and Labette. The river eventually empties into the Arkansas River in Oklahoma which in turn empties into the Mississippi River. The stream bottoms are sandy in the extreme upper and lower portions of the drainage while the remainder has a bottom of mud mixed with fine to large cobble. Certain isolated areas are composed of bedrock with very little silt or mud. In general, turbidity and rate of flow increase as the river runs from its origin in the Flint Hills to where it leaves the state at the Kansas-Oklahoma border. Turbidity greatly increases in areas where the land surrounding the river has been cultivated.

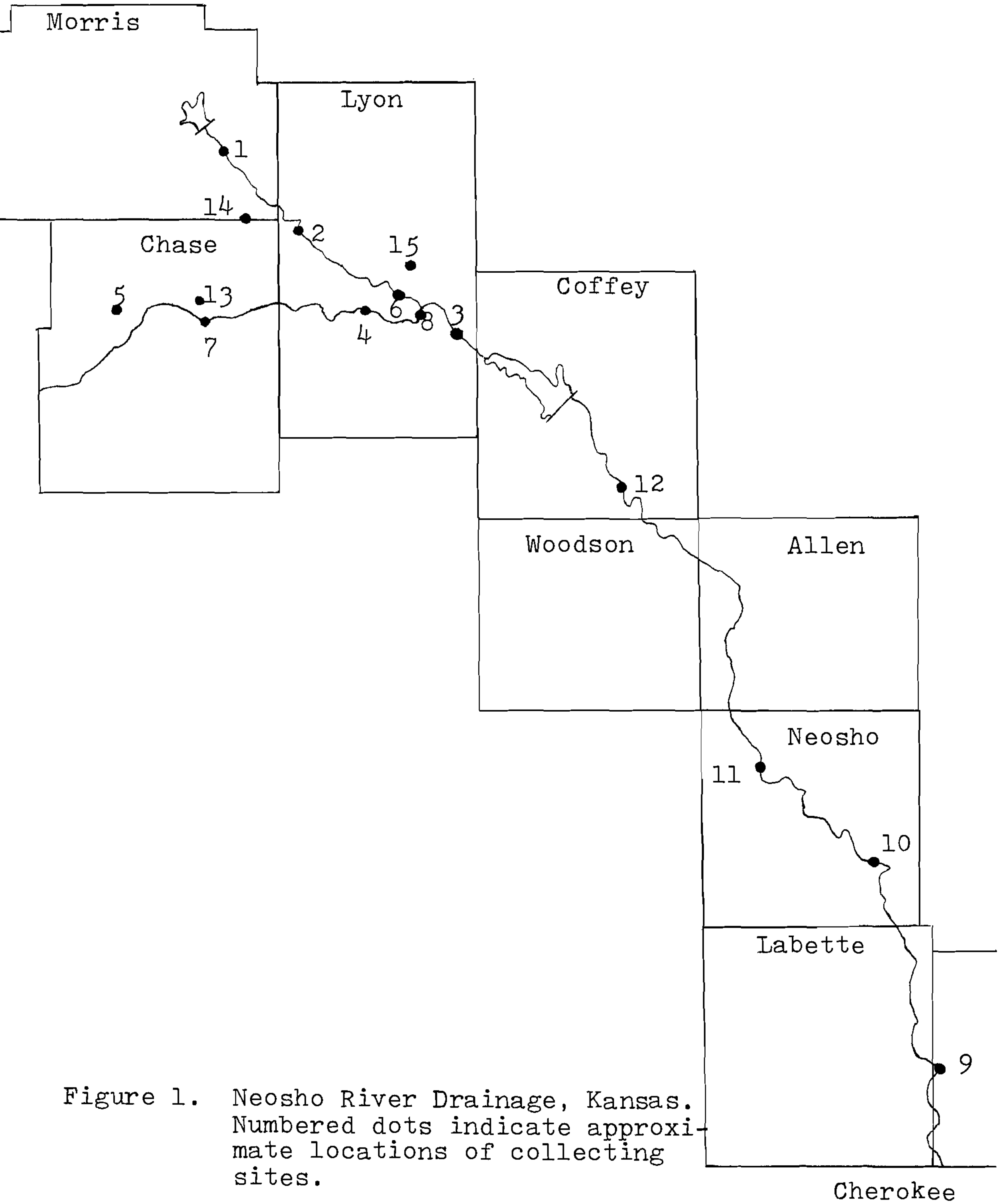

Figure 1. Neosho River Drainage, Kansas. Numbered dots indicate approximate locations of collecting sites.

METHODS AND MATERIALS

Several methods were examined for collecting fresh-water mussels at the beginning of this study. Use of the bottom rake, a device resembling an ordinary garden rake, proved unsuccessful. It has been used quite successfully in the eastern states, but the large cobble in the substrate of the Neosho River hindered its operation. The bottom glass also proved unsuccessful due to the high turbidity of the water. Although time consuming, the hand method proved to be the most successful method of collecting. By feeling along the bottom the mussels could be located and brought from the water. Collected mussels were either identified immediately and returned to the water or they were placed in a sack for later identification. Fortunately, most species of Kansas unionids could be identified by their external morphology and being able to avoid cutting the mussel open for identification purposes reduced the waste of this valuable benthic inhabitant.

Occurrence of empty mussel shells along the banks served as the major criteria in choosing a collecting site. The number of empty shells on the bank corresponded with the number of live mussels found in the surrounding water. In areas where few or no empty shells were found, there were few live specimens collected.

After a collecting site was selected, live specimens were collected in the following manner: two points about 50 meters apart were established along the bank and the substrate was searched by use of the hands from the first point to the second, covering a 1.5 meter width. Upon reaching the second point, the process was repeated until the entire width of the river or pond was covered. Another 50 meter length was then searched and this was repeated until a total of 200 to 400 meters of the bottom was searched.

Collected specimens were prepared by first slicing length-wise through the ligament with a sharp knife, then slipping a thin blade between the valves and cutting the adductor muscles. The separated valves could then be easily cleaned. This method also left the internal parts intact in case they were needed for identification. Specimens which could not be identified immediately were preserved in a 10 % formalin solution.

Specimens were identified using the keys by Murray and Leonard (1962) and Burch (1975). Identifications were verified by Dr. H. D. Murray of Trinity University and Dr. D. H. Stansbery of Ohio State University. A reference collection was made using at least one representative of each species collected and the collection was presented to the Division of Biological Sciences, Emporia State University.

Figure 1 is a map of sites and counties where a search was conducted for unionid mussels. The descriptions and dates listed below correspond with the numbered collecting sites shown in Figure 1.

1. Council Grove, Sec. 14/24, T16S, R9E, Morris Co., Kansas (both in city limits and one mile south of town). Sep. 17 and Oct. 26, 1976.

2. Two and one-half miles west of Americus, Sec. 4/9, T18S, R10E, Lyon Co., Kansas. Oct. 12, 1975; Apr. 5 and Jul. 13, 1976.

3. One-quarter mile west of Neosho Rapids, Sec. 19, T19S, R13E, Lyon Co., Kansas. Oct. 19, 1975, Sep. 16, 1976.

4. Soden's Grove, Emporia, Sec. 22, T19S, R11E, Lyon Co., Kansas. Mar. 11 and Jul. 13, 1976.

5. Middle Creek, six miles west of Elmdale, Sec. 15, T19S, R6E, Chase Co., Kansas. Jun. 26, 1976.

6. Three miles east of Emporia, Sec. 8/9/16/17, T19S, R12E, Lyon Co., Kansas. Jul. 10, 1976.

7. One-half mile southwest of Cottonwood Falls, Sec. 27, T19S, R8E, Chase Co., Kansas. Jul. 11, 1976.

8. Seven and one-half miles east, one and one-half miles south of Emporia, Sec. 22/27, T19S, R12E, Lyon Co., Kansas. Sep. 2, 1976.

9. One and one-half miles east of Oswego, Sec. 13/24, T33S, R21E, Labette Co., Kansas. Sep. 18, 1976.

10. One and one-half miles west, one mile south of St. Paul, Sec. 15/16/21/22, T29S, R20E, Neosho Co., Kansas. Sep. 18, 1976.

11. One-quarter mile east of Chanute, Sec. 22, R18E, T27S, Neosho Co., Kansas. Sep. 19, 1976.

12. One-quarter mile west of Leroy, Sec. 33, T22S, R16E, Allen Co., Kansas. Sep. 19, 1976.

13. Fox Creek, one-half mile west, one mile north of Strong City, Sec. 8, R8E, T18S, Chase Co., Kansas. Jul. 11, 1976.

14. Lake Kahola, nine miles west, eight miles north of Emporia, Sec. 32/33, T17S, R9E, Morris Co., Sec. 3/4, T18S, R9E, Chase Co., Kansas. Apr. 12, 1976.

15. Farm pond, five miles north, five miles east of Emporia, Sec. 22, T18S, R12E, Lyon Co., Kansas. Sep. 25, 1976.

RESULTS AND DISCUSSION

Species Collected

Approximately 2,300 individuals of unionid mussels representing 20 genera and 32 species were found (Table 1). They exhibited a wide range of habitat, occurring in substrates of sand, mud, and mud mixed with cobble. The most preferred habitat was silt mixed with small gravel. Few live specimens were found in substrates which consisted of strictly bedrock or cobble. In general, a suitable substrate for unionid mussels was sand, silt, or mud. The substrate of the Neosho River in the city limits of Council Grove and at Fox Creek, north of Strong City, consisted almost entirely of bedrock and large cobble. No live unionid mussels and few empty shells were found at those locations.

Mussels were collected in water ranging in depth from 15 cm to 2 m. The majority of individuals collected were found in water 0.5 to 1 m deep. Unionid mussels move to shallow water to reproduce in early fall, during winter months they occupy the deeper waters of their habitat. Most species occurred in water of intermediate depths (about 1 m) during summer months.

Results of this study were compared with the studies of Call (1885), Scammon (1906), and Murray and Leonard (1962). It appeared that the numbers of unionid mussels in the Neosho River drainage have steadily declined to present day popula-

TABLE I

LIST OF SPECIES COLLECTED

TAXA	No. Found	% of Total Collected
UNIONIDAE		
UNIONINAE		
Fusconaia flava	35	1.5
Megalonaias gigantea	17	0.7
Amblema peruviana peruviana	33	1.4
Amblema peruviana costata	706	30.8
Quadrula quadrula	319	13.9
Quadrula pustulosa	123	5.4
Quadrula nodulata	5	0.2
Quadrula metanevra	41	1.8
Tritogonia verrucosa	255	11.1
Pleurobema cordatum coccineum	empty shell only	-
Pleurobema cordatum catillus	6	0.3
Pleurobema cordatum pyramidatum	2	0.1
Elliptio dilatatus	45	2.0
Uniomerus tetralasmus	30	1.3
ANODONTINAE		
Lasmigona costata	empty shell only	-
Lasmigona complanata	110	4.8
Anodonta grandis	13	0.6
Strophitus undulatus	3	0.1
LAMPSILINAE		
Obliquaria reflexa	50	2.2
Truncilla truncata	27	1.2
Truncilla donaciformis	40	1.7
Plagiola lineolata	2	0.1
Leptodea fragilis	248	10.8
Leptodea laevissima	9	0.4
Proptera alata	5	0.2
Proptera purpurata	77	3.4
Carunculina parva	12	0.5
Ligumia subrostrata	17	0.7
Ligumia recta latissima	empty shells only	-
Lampsilis teres form *teres*	42	1.8
Lampsilis ovata ventricosa	25	1.1
Ptychobranchus occidentalis	4	0.2

tions. Scammon and Murray and Leonard reported increased siltation and industrial pollution as major factors for the declining unionid mussel population. There was indication that water temperatures have not changed significantly since the study by Murray and Leonard.

Murray and Leonard (1962) conducted their study 18 years ago. Since then the nomenclature has changed for many unionids. In this study, the genus, species, and subspecies names most currently recognized were used. The following is a descriptive list of species of unionid mussels found in this study and reported by Murray and Leonard as occurring in the Neosho River drainage. Appearing in parenthesis under the technical name in certain species are the scientific names used by Murray and Leonard if different than the currently recognized name.

Wabash Pig-Toed Mussel

Fusconaia flava (Rafinesque)

Fusconaia flava was commonly occurring mussel in the Neosho River drainage. It was collected from north Lyon County south to the Kansas-Oklahoma border. It was also collected from the Cottonwood River near Cottonwood Falls, Kansas. Murray and Leonard (1962) did not report *F. flava* from the Cottonwood River although they did include it in their area of approximate distribution. It was generally found in water 0.5 to 3 m deep on a substrate of mud mixed with gravel. F. flava was found at collecting sites 2, 3, 7, 9, 10, 11, and 12 (Fig. 1).

Giant Washboard Mussel

Megalonaias gigantea (Barnes)

Megalonaias gigantea occurred rarely north of Allen County and more commonly south of that point. Its distribution matched that reported by Murray and Leonard (1962). Several specimens were collected from water no deeper than 15 cm. Others occurred in water from 1 to 2 m deep. Murray and Leonard reported they never collected *M. gigantea* in less than 2 m of water. It was found in substrates ranging from sand to mud mixed with gravel. *M. gigantea* was found at collecting sites 8, 9, 10, 11, and 12 (Fig. 1).

Blue Point Mussel

Amblema peruviana peruviana (Lamarck)

Amblema peruviana peruviana occurred commonly south of Allen County to the state line. Its distribution compared with that reported by Murray and Leonard (1962). It was generally found in water 0.5 to 2 m deep on a substrate of mud mixed with medium to large gravel. *A. peruviana peruviana* was found at collecting sites 9, 10, and 11 (Fig. 1).

Three-Ridged Mussel

Amblema peruviana costata (Rafinesque)

Amblema peruviana costata replaced *A. peruviana peruviana* north of Allen County, occurring quite commonly. At collection site 2 (Fig. 1) over 500 individuals were found in an area covering less than 100 m^2. *A. peruviana costata* occurred in water two to five feet deep on a substrate of mud mixed with medium to large gravel. A. peruviana costata was found at collecting sites 1, 2, 3, 4, 5, 6, 8, 12, and 14 (Fig. 1).

Maple-Leaf Mussel

Quadrula quadrula Rafinesque

Quadrula quadrula was one of the most commonly occurring mussels in the Neosho River drainage. It was found at all collecting sites except 5, 13, and 15 (Fig. 1) and its distribution matched that reported by Murray and Leonard (1962). Q. quadrula was found on every type of substrate that supported live mussels in the Neosho River drainage, from sand to mud mixed with large cobble.

Pimple-Backed Mussel

Quadrula pustulosa (Lea)

Quadrula pustulosa occurred as commonly as Q. quadrula and with the same distribution. Its distribution compared with that reported by Murray and Leonard (1962). The habitats of Q. pustulosa matched that of Q. quadrula. Q. pustulosa was found at all collecting sites except 13 and 15 (Fig. 1).

Warty-Backed Mussel

Quadrula nodulata Rafinesque

Murray and Leonard (1962) reported collecting Quadrula nodulata at only two locations in Kansas, both on the Neosho

River. In this study, five specimens of *Q. nodulata* were collected from site 8 (Fig. 1). This was one of the two locations where Murray and Leonard also collected *Q. nodulata*. It is quite rare in the Neosho River drainage. The five individuals were collected in water 30 cm to 1 m deep on a substrate of mud mixed with gravel.

Monkey-Faced Mussel

Quadrula metanevra Rafinesque

Quadrula metanevra occurred quite commonly south of Allen County. Murray and Leonard (1962) reported that *Q. metanevra* probably did not occur north of Coffey County. However, in this study two specimens were collected in central Lyon County. Their occurrence there suggests that *Q. metanevra* exists in suitable habitats north of Allen County but only rarely. *Q. metanevra* was found in water 15 cm to 1 m deep and on substrates of sand and mud mixed with small to medium sized gravel. *Q. metanevra* was found at collecting sites 8, 9, 10, 11, and 12 (Fig. 1).

Spectacle-Case Mussel

Quadrula cylindrica (Say)

Quadrula cylindrica was last reported in Kansas in the Neosho River in 1955. No live or empty shells were collected in this study. If *Q. cylindrica* presently occurs in the Neosho River drainage, it is rare.

Buckhorn Mussel

Tritogonia verrucosa (Say)

Tritogonia verrucosa occurred in large numbers throughout the Neosho River drainage. It was one of the more abundant habitants at each collecting site where mussels occurred. Its distribution compared with that reported by Murray and Leonard (1962). It generally occurred in 0.5 to 2 m of water on a substrate of mud mixed with small to large gravel. *T. verrucosa* was found at collecting sites 1, 2, 3, 4, 7, 8, 9, 10, 11, and 12 (Fig. 1).

Round Pig-Toed Mussel

Pleurobema cordatum coccineum (Conrad)

An empty shell thought to be *Pleurobema cordatum coccineum* was found at collecting site 8 (Fig. 1). Since the soft parts of the animal were not present, Stansbery (Appendix) could not make a positive identification. He did conclude that the specimen was either *Fusconaia flava* or *P. cordatum coccineum*. This study chose the latter since the umbo was positioned farther anterior than typical specimens of *F. flava*. Murray and Leonard (1962) thought *P. cordatum coccineum* might rarely occur in the headwaters of the Neosho River drainage.

Solid Pig-Toed Mussel

Pleurobema cordatum catillus (Conrad)

Murray and Leonard (1962) reported *Pleurobema cordatum catillus* as occurring in only two localities in Kansas, both in the southern part of the Neosho River and then only rarely. During this study no live specimens of P. cordatum catillus were found. However, numerous empty shells were found from western Lyon County south to the Kansas-Oklahoma border. This suggests that P. cordatum catillus has a larger range and a larger population density in the Neosho River than previously reported by Murray and Leonard. P. cordatum catillus was found at collecting sites 2, 9, and 12 (Fig. 1).

Pyramid Pig-Toed Mussel

Pleurobema cordatum pyramidatum (Lea)

Two empty shells of Pleurobema cordatum pyramidatum were collected from the Neosho River, one in Lyon County and the other in Allen County. There is little doubt that P. cordatum pyramidatum still occurs in the Neosho River drainage but only rarely. The two collected specimens were within the distribution range reported by Murray and Leonard (1962). The population of P. cordatum pyramidatum, however, appears to have declined since the time of the Murray and Leonard study. P. cordatum pyramidatum was found at collecting sites 8 and 12 (Fig. 1).

Lady-Finger Mussel

Elliptio dilatatus (Rafinesque)

Elliptio dilatatus was collected occasionally in the Neosho River north of Allen County and commonly south of Allen County. Its distribution compared with that reported by Murray and Leonard (1962). E. dilatatus was found in water 30 cm to 1 m deep and on substrates of sand and mud mixed with small to large gravel. _E_. _dilatatus_ was found at collecting sites 2, 3, 6, 7, 8, 9, 10, 11, and 12 (Fig. 1).

Pond Horn Mussel

Uniomerus tetralasmus (Say)

Uniomerus tetralasmus occurred throughout the entire range of the Neosho River drainage, although it rarely was found in streams and rivers. _U_. _tetralasmus_ most often was found in lakes, ponds, and other still bodies of water. Its distribution compared with that reported by Murray and Leonard (1962). _U_. _tetralasmus_ was found in water 8 to 30 cm in depth on substrates of sand or soft mud. _U_. _tetralasmus_ was found at collecting sites 9, 14, and 15 (Fig. 1).

Fluted Mussel

Lasmigona costata (Rafinesque)

Murray and Leonard (1962) reported _Lasmigona costata_ as being extremly rare in Kansas. Failure to find any live specimens supports their claim. An empty shell was found at collecting site 4 (Fig. 1), indicating that _L_. _costata_ still occurs in the Neosho River drainage. Most probably it is found no farther north than Lyon County. _L_. _costata_ is reported to inhabit gravel or riffle areas.

White Heel-Splitter Mussel

Lasmigona complanata (Barnes)

Lasmigona complanata was a commonly collected mussel throughout the Neosho River drainage. It occurred on almost all types of substrates ranging from sand to large cobble mixed with mud and in water from 15 cm to 1 m deep. Its distribution compared with that reported by Murray and Leonard (1962). *L. complanata* was found at collecting sites 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, and 14 (Fig. 1).

Floater Mussel
Anodonta grandis Say

Murray and Leonard (1962) reported *Anodonta grandis* as common in eastern Kansas including the Neosho River drainage. However, *A. grandis* was found to be common only in the southern portions of the drainage. When found north of Coffey County, it was as isolated specimens and never in large numbers. This could be due to the fact that riffle areas were more often searched than the quiet pond-like areas which *A. grandis* prefers. It was generally found in water 15 cm to 1 m deep. *A. grandis* was found at collecting sites 5, 6, 9, 10, 11, and 12 (Fig. 1).

Squaw-Foot Mussel
Strophitus undulatus (Say)
(*Strophitus rugosus* (Swainson))

Strophitus undulatus was collected from only one location, collecting site 2 (Fig. 1). It probably occurs in the southern portions of the Neosho River drainage but it is not common there. Murray and Leonard (1962) reported it as occurring throughout Southeastern Kansas. It appears that *S. undulatus* is declining in population in the drainage. The three specimens that were collected were found in 15 cm of water on a substrate of silt mixed with fine gravel.

Three Horned Wart-Backed Mussel

Obliquaria reflexa Rafinesque

Murray and Leonard (1962) reported *Obliquaria reflexa* as being restricted to the lower portion of the Neosho River. However, in this study *O. reflexa* was collected quite commonly in the Neosho River drainage as far north as Emporia and as far west as Cottonwood Falls, Kansas. This exceeded the range reported by Murray and Leonard. Based on the number of specimens collected, *O. reflexa* now appears to be a common inhabitant of the Neosho River drainage. *O. reflexa* was found at collecting sites 3, 4, 6, 7, 8, 9, 10, 11, and 12 (Fig. 1).

Young Fan-Tailed Mussel

Cyprogenia aberti (Conrad)

Cyprogenia aberti has not been collected from Kansas since 1906. No live specimens nor empty shells were found in the Neosho River drainage during this study. If *C. aberti* presently occurs in the drainage, it is very rare.

Mucket Mussel

Actinonaias carinata carinata (Barnes)

See *Ptychobranchus occidentalis* (Conrad) page 25.

Deer Toe Mussel

Truncilla truncata Rafinesque

Truncilla truncata was commonly collected in the Neosho River drainage, although Murray and Leonard (1962) reported its occurrance as rare. It appears that *T. truncata* has increased in number since the time of the Murray and Leonard study. Its distribution, however, did compare with that reported by Murray and Leonard. *T. truncata* was generally found in water 30 cm to 1 m deep and on substrates of either sand or fine gravel mixed with mud. *T. truncata* was found at collecting sites 2, 3, 6, 7, 9, 10, 11, and 12 (Fig. 1).

Fawn's Foot Mussel

Truncilla donaciformis (Lea)

Truncilla donaciformis was commonly collected in the Neosho River drainage north to Americus, Kansas, west to Cottonwood Falls, Kansas, and south to the Kansas-Oklahoma state line. This extends the range further west and north than reported by Murray and Leonard (1962). Their reported range extended north only to the western edge of Coffey County. It was generally found in water 15 cm to 1 m deep and on substrates of either sand or fine gravel mixed with mud. *T. donaciformis* was found at collecting sites 2, 3, 4, 6, 7, 9, 10, 11, and 12 (Fig. 1).

Butterfly Mussel

Plagiola lineolata (Rafinesque)

Plagiola lineolata was collected only from site 9 (Fig. 1) in the Neosho River drainage. Murray and Leonard (1962) reported *P. lineolata* occurring no farther north than Iola in Allen County. Its occurrence appeared to be rare and only in the southern portion of the Neosho River. The two collected specimens were found in 30 cm of water on a sandy substrate.

Fragil-Paper Mussel

Leptodea fragilis (Rafinesque)

Leptodea fragilis was one of the more commonly found mussels in the Neosho River drainage. It occurred throughout the entire drainage and its distribution compared with that reported by Murray and Leonard (1962). *L. fragilis* was found in water 15 cm to 1 m deep and on a variety of different substrates ranging from sand to large cobble mixed with mud. *L. fragilis* was found at all collecting sites except 5, 13, 14, and 15 (Fig. 1).

Paper-Shell Mussel

Leptodea laevissima (Lea)

Leptodea laevissima was collected throughout the entire Neosho River drainage but was not common. This study found the range and distribution of *L. laevissima* compared with that reported by Murray and Leonard (1962). When *L. laeviss-*

ima was found in rivers or streams, it was always in shallow water on a substrate of sand or mud mixed with fine gravel. In lakes, ponds, or bodies of still water *L. laevissima* occurred in water from 8 cm to 1 m deep. *L. laevissima* was found at collecting sites 8, 9, 10, and 14 (Fig. 1).

Pink Heel-Splitter Mussel
Proptera alata (Say)

Proptera alata was found throughout the Neosho River drainage, commonly in the southern portion and only rarely north of Coffey County. Murray and Leonard (1962) reported it as common in the Neosho River. It appears that its population is declining in the northern portions of the Neosho River drainage. It generally occurred in water .5 to 1.5 m deep on substrates ranging from sand to large cobble mixed with mud. Its range compared with that reported by Murray and Leonard. *P. alata* was found at collecting sites 2, 9, 10, 11, and 12 (Fig. 1).

Purple Shell Mussel
Proptera purpurata (Lamarck)

Proptera purpurata was quite common throughout the Neosho River drainage. Its range and distribution compared with that reported by Murray and Leonard (1962). *P. purpurata* was found most often in water 0.5 to 2 m deep and on substrates ranging from silt to large cobble mixed with mud. *P. purpurata* was found at all collecting sites except 5, 13, 14, and 15 (Fig. 1).

Pocketbook Mussel

Proptera capax (Green)

Murray and Leonard (1962) collected the only specimen of *Proptera capax* ever reported from Kansas in the Neosho River in 1956. This study found neither live specimens nor empty shells anywhere in the Neosho River drainage. If *P. capax* still occurs in the drainage, it is quite rare.

Lilliput Mussel

Carunculina parva (Barnes)

Carunculina parva was collected from only three locations in the Neosho River drainage although Murray and Leonard (Fig. 1) reported it as common in eastern Kansas. Failure to find *C. parva* in greater numbers was probably due to its small size and the fact that its preferred habitat of quiet pools and mud bottoms were not searched as extensively as other habitats. Collected specimens were found in water 5 to 15 cm deep on mud substrates. *C. parva* was found at collecting sites 5, 8, and 15 (Fig. 1).

Black Sand Mussel

Ligumia recta latissima (Rafinesque)

Murray and Leonard (1962) reported there were no valid records of *Ligumia recta latissima* from the Neosho River drainage. Although no live specimens were collected, several empty shells were found at sites 2, 6, 8, 9, 10, and 12 (Fig. 1), indicating its presence in the Neosho River.

Common Pond Mussel

Ligumia subrostrata (Say)

Ligumia subrostrata was commonly found throughout the Neosho River drainage but only in ponds, lakes, or the pond-like areas of rivers and streams. No specimens were found in flowing water. Its range and distribution compared with that reported by Murray and Leonard (1962). *L. subrostrata* was found in water 8 cm to 1 m deep on a substrate of mud. *L. subrostrata* was found at collecting sites 5, 9, 14, and 15 (Fig. 1).

Yellow Sand-Shell Mussel

Lampsilis teres form *teres* (Rafinesque)

(*Lampsilis anodontoides anodontoides* (Lea))

Lampsilis teres form *teres* was a commonly collected mussel throughout the Neosho River drainage. Its range and distribution compared with that reported by Murray and Leonard (1962). *L. teres* form *teres* was most often found in water .5 to 1.5 m deep and on substrates of mud, silt, or fine gravel mixed with mud. *L. teres* form *teres* was found at all collecting sites except 5, 13, 14, and 15 (Fig. 1).

Slough Sand Mussel

Lampsilis teres form *fallaciosa* (Smith)

(*Lampsilis anodontoides fallaciosa* Smith))

Murray and Leonard (1962) reported *Lampsilis teres* form *fallaciosa* from the southern portions of the Neosho River. Although no live specimens or empty shells were collected from the Neosho River drainage, there is no reason to doubt its occurrance in the southern portions of that drainage. Failure to find any evidence of *L. teres* form *fallaciosa* was probably due to inadequate collecting rather than it being absent from the drainage.

Fat Mucket Mussel

Lampsilis radiata siliquoidea (Barnes)

Murray and Leonard (1962) reported *Lampsilis radiata siliquoidea* as being rare in the Neosho River drainage. Failure to find any live specimens and empty shells was probably due to inadequate collecting. There is no reason to doubt that *L. radiata siliquoidea* occurs in suitable habitats of the Neosho River.

Plain Pocketbook Mussel

Lampsilis ovata ventricosa (Barnes)

Lampsilis ovata ventricosa occurred quite commonly throughout the Neosho River drainage. Its distribution and range compared with that reported by Murray and Leonard (1962).

L. ovata ventricosa was most often found in water .5 to 1.5 m deep on substrates of mud mixed with medium to large gravel. *L. ovata ventricosa* was found at collecting sites 2, 3, 4, 7, 9, 10, 11, and 12 (Fig. 1).

Ptychobranchus occidentalis (Conrad)

It appears that the mussel identified by Murray and Leonard (1962) as *Actinonaias carinata carinata* (Barnes) was incorrectly recorded. Several specimens collected in this study were identified by Murray as *A. carinata carinata*. However, the lateral teeth are shorter, too curved, too swollen posteriorly, and the posterior slope is too narrow to be *A. carinata carinata*. By using the key and descriptions from other sources, the preference is to identify the specimens as *Ptychobranchus occidentalis*. This was verified by Dr. Stansbery of Ohio State University. The identifications were verified by comparing the collected specimens with specimens of *P. occidentalis* and *A. carinata carinata* from the Ohio and Mississippi drainages.

Murray and Leonard (1962) reported specimens they identified as *A. carinata carinata* as occurring no further north than the western edge of Allen County. However, in this study, several specimens were collected as far north as western Lyon County. *P. occidentalis* appears to have a larger range than previously reported. It was found most often on a substrate of mud mixed with large cobble. *P. occidentalis* was found at collecting sites 2, 8, and 12 (Fig. 1).

Unknown Species

On April 5, 1976, the right valve of a unionid mussel was found in the Neosho River at collecting site 2 (Fig. 1). It appeared to be an abnormal specimen of some species which normally occurs in the Neosho River drainage. Neither Murray nor Stansbery (Appendix) could provide a positive identification. It is doubtful that the specimen is a genetic variant or intergrade, which would place it in a definable subspecies.

Water Temperature and Turbidity

Water temperature and turbidity data were recorded at each collecting site in hopes of comparing them with the data recorded by Murray and Leonard (1962) at the time of their study. Unfortunately, their data are no longer available, having been sent to the Smithsonian Institute in Washington, D. C. Table II shows the physical data recorded in this study and the water temperature data that was available as average temperatures recorded at various sites for the years 1950 to 1972 by the Kansas Water Resources Board (1975). Turbidity appears in APHA turbidity units obtained from a Hellige Turbidimeter. Water temperature was taken at a 1 m depth in each instance.

From the information that was available, the water temperature data that was recorded in this study was well within the range that was reported for the years 1950 to 1972. It appears that no changes have occurred in water temperature

TABLE II

WATER TEMPERATURE AND TURBIDITY DATA BY COLLECTION SITE

Collection Site	Water Temp. (°C)	Turbidity APHA Units	Month	From Ks. Water Board Temp (°C) Mean.	Max.	Min.
1	23.33	19.5	Sep.	22.8	30.5	18.0
2	24.44	16.5	July	26.0	32.0	21.0
3	22.22	118.0	Sep.	*	*	*
4	27.22	231.0	July	*	*	*
5	22.78	66.0	June	*	*	*
6	27.78	190.0	July	*	*	*
7	27.78	100.0	July	27.9	34.0	21.0
8	23.33	62.5	Sep.	*	*	*
9	26.11	86.0	Sep.	*	*	*
10	25.56	68.0	Sep.	*	*	*
11	25.56	52.0	Sep.	22.6	26.5	16.5
12	25.00	43.0	Sep.	24.0	28.5	15.5

* Data not available

in the last four years which would significantly alter the habitats of unionid mussels in the Neosho River drainage.

Since no data were available for comparison of turbidity data, no inference could be made as to the increase or decrease of sediment in the Neosho River drainage since the time that Murray and Leonard (1962) conducted their study.

SUMMARY

From September, 1975, through October, 1976, unionid mussels were collected and identified from the Neosho River drainage. Results were compared with the work of Murray and Leonard (1962). Water temperatures and turbidity readings were recorded and compared with data from 1950 through 1972 from the same river drainage.

Over 2,300 live specimens representing 32 species were collected. Amblema peruviana costata, Quadrula quadrula, Tritogonia verrucosa, and Leptodea fragilis were the most abundant species, comprising two-thirds of all unionids found (Table I). Murray and Leonard (1962) reported 37 species of unionid mussels occurring in the Neosho River drainage. This study found 32 species presently occurring in the drainage. Of the remaining five species, two species, Lampsilis radiata siliquoidea and L. teres form fallaciosa were not found probably because of inadequate collecting rather than their being absent from the drainage. The other three species, Quadrula cylindrica, Cyprogenia aberti, and Proptera capax, have not been reported from the drainage for many years. Their occurrence today in the Neosho River drainage is questionable.

Several species of unionid mussels were found to have a greater range and density than reported by Murray and Leonard (1962). This could be due to the fact that this study concentrated on only one river drainage. Murray and Leonard

conducted their study statewide, thus being unable to concentrate as much on any one particular area. Species of unionid mussels that were found to have a smaller range and density were judged to be on the decline due to increased pollution and siltation in the drainage.

Actinonaias carinata carinata as reported by Murray and Leonard (1962) was found to be incorrectly identified. It was correctly identified during this study as *Ptychobranchus occidentalis*, a species not previously reported in Kansas.

From the information available, it appeared that the water temperature of the Neosho River drainage has not changed significantly since the study by Murray and Leonard (1962). No information could be found with which to compare turbidity data from the time of the Murray and Leonard study with that collected in this study.

LITERATURE CITED

LITERATURE CITED

Burch, J. B. 1975. Freshwater unionacean clams (Mollusca: Pelecypoda) of North America. Museum and Dept. of Zoo., Univ. Michigan and The Australian Museum. 203 p.

Call, R. E. 1885a. Contributions to a knowledge of the fresh-water Mollusca of Kansas, I, fresh-water bivalves. Bull. Washburn College Lab. Nat. Hist., Vol. 1(2)48-51.

Kansas Water Resources Board. 1975. Temperature of Kansas streams. Tech. report #12. 262 p.

Murray, H. D. and A. B. Leonard. 1962. Unionid mussels in Kansas. Misc. Publ. Univ. Kansas Mus. Nat. Hist., 184 p.

Scammon, R. E. 1906. The Unionidae of Kansas, part I. Univ. Kansas Sci. Bull., Vol. 3, 279-373.

Schoewe, W. H. 1949. The geography of Kansas, part II, physical geography. Trans. Kansas Acad. Sci., Vol. 52, 261-333.

APPENDIX

TRINITY UNIVERSITY
715 STADIUM DRIVE SAN ANTONIO, TEXAS 78284

PARTMENT OF BIOLOGY

June 28, 1976

Mr. Joe Frazier
902 Lincoln
Emporia, Kansas 66801

Dear Mr. Frazier:

Yes, I would be most interested in examining your reference collection. I am most pleased to see that you are undertaking this work. I just returned from Kansas today and came through Emporia on Saturday, 26 June, 1976. It is unfortunate that I did not know of your work until I returned.

I do not know what happened to the data concerning water temperature, turbidity, etc. These items were in my field notes which I was required to leave at Kansas University with the collections. After I left they moved all the Kansas mollusks (including my unionids) to the Smithsonian in Washington, D.C. I, therefore, do not know what happened to the field notes. Dr. A. Byron Leonard is still at Kansas University, and he may be able to answer your question. I do not know.

I await with great interest to examine the Neosho River fresh water mussels.

Sincerely,

Harold D. Murray

Harold D. Murray, Ph.D.,
Chairman, Professor of Biology

HDM/smh

TRINITY UNIVERSITY
715 STADIUM DRIVE SAN ANTONIO, TEXAS 78284

EPARTMENT OF BIOLOGY

July 21, 1976

Mr. Joe Fraizer
902 Lincoln
Emporia, Kansas 66801

Dear Mr. Frazier:

I have received your specimens and examined the materials. All specimens arrived in excellent condition except Proptera purpurata which had the ventral-pasterior margin broken.

Your specimens are indeed beautiful ones. I concur 100% with your identifications. It is my judgement that 76020 Lampsilis anodontoides and 76023 L. anodontoides are best identified as subspecies anodontoides as the rays are certainly faint.

I shall repack your material for return as soon as I can. If I may be of additional help to you, please feel free to call upon me.

Sincerely,

Harold D. Murray

Harold D. Murray, Ph.D.,
Chairman, Professor of Biology

HDM/smh

TRINITY UNIVERSITY
715 STADIUM DRIVE SAN ANTONIO, TEXAS 78284

PARTMENT OF BIOLOGY

October 26, 1976

Joe Frazier
2 Lincoln
poria, Kansas 66801

ar Mr. Frazier:

ur specimens arrived in excellent condition. I have examined em, and I concur with your identifications except for one.

mpsilis radiata siliquoidea (76065) just does not seem right. have compared it to all photographs I can find, to a few specimens have on hand, and to descriptions in the literature. I do not ink it is L. radiata siliquoidea. My reasons for doubt are:

1) the posterior slope runs to far ventrad for a typical L. radiata siliquoidea.

2) the ventral margin seems to be too rounded for a typical L. radiata siliquoidea.

3) the position of the umbo seems too far anterior.

at is 76065? I do not know. I recommend the shell be forwarded either Dr. Carol Stein or Dr. David Stansbury, Museum of Zoology, io State University, 1813 North High Street, Columbus, Ohio, 43210. you would like, I would be happy to send a letter of explanation d introduction for you so that they will understand the problem.

ease let me know how you wish to proceed. I will be returning your terial within a week.

I may be of further aid, please let me know.

ncerely,

Harold D. Murray

rold D. Murray, Ph.D.,
airman, Professor of Biology

DM/smh

THE OHIO STATE UNIVERSITY

20 December 1976

oe Frazier
incoln
ia, Kansas 66801

Mr. Frazier:

Your letter of introduction from Dr. Harold Murray has been here for al weeks now and I have looked forward to examining your specimen.

The specimen and your letter were brought to me this morning by Dr. Carol ein, our Curator of Gastropods. It is indeed a very interesting valve and I asily understand that it has caused some uncertainty.

First of all, I must agree with Dr. Murray that this specimen is most bly not Lampsilis radiata luteola (Lamarck, 1819). [NOTE: Unio luteolus ck, 1819, is a synonym of and has priority over Unio siliquoideus Barnes, 1823.] haracteristics of this valve do not match any described species of North Ameri- aiad known to me. I strongly suspect it to be an abnormal specimen of a species in the Neosho River system and perhaps associated river systems. Such speci- turn up from time to time and we have a few here to be identified (25±) out of eds of thousands that have been processed into the collection. Considering usceptible these animals are to environmental influence, we really should t at least this many or more problems of this nature.

Some of these problems are solved from time to time when adequate series ollected and we can connect the unknown specimen(s) with some known species gh a set of environmental intergrades. Rarely, in recent times, do single em specimens turn out to represent populations of genetic variants, geographi- definable, and intergrading somewhere along the margin of their range with er taxon. In such cases we, of course, would have a definable subspecies. ut the intergradation we may have a sibling species. Usually, however, we ually find similar material and more typical material of a well-known species near the original collecting site of the problem shell which "connects" with

The best possibility for obtaining the identification of your specimen seem to lie in making a large collection at or near the source of this speci- ith the possibility of finding intermediate forms as noted above. Do you

College of Biological Sciences, Museum of Zoology 1813 North High Street Columbus, Ohio 43210 Phone (614) 422-8560

or can you make such a collection? Even subfossil material, if in numbers, help. A single gravid female of this form might well go a long way toward entification. Many of our generic characteristics are found in the soft rather than the anatomy of the shell.

We have very little material from the Neosho although we have a fair t from the Spring River -- mostly from sites in Missouri. None of these mens resemble your problem valve at all closely.

If you can supply additional material from the Neosho, I'd be happy to a second effort at identification. If this is not reasonably possible, let ow and I'll return your specimen.

I could go on at length about why your specimen is most likely not one es or another but would rather respond to any particular questions you may

Having so little material from your area, I would be pleased to exchange cates from central and eastern North America for any duplicates you may have. uld also be willing to deposit voucher specimens from your study here at OSUM u wish.

Sincerely,

David H. Stansbery
Director and Professor

ls

Dr. Harold Murray

THE OHIO STATE UNIVERSITY

28 January 1977

r. Joe Frazier
)2 Lincoln
nporia, Kansas 66801

ear Mr. Frazier:

Your duplicate specimens arrived here in fairly good shape yesterday
th only a few casualities and none that an hour or so with the glue pot
n't at least restore. The P. laevissima (Lea, 1829) was hardest hit and
currently in a dozen pieces. Your packing should have been sufficient
it the treatment is sometimes rougher than usual.

We are very much pleased to have the specimens and I am impressed with
neir cleaned condition and neat numbering. Since texture of periostracum
s sometimes an important taxonomic character I would rather you hadn't taken
ne trouble to varnish or shellac them. We dip our specimens in a solution
f parafin dissolved in xylene to reduce cracking. This is done after clean-
ng and numbering. Parafin is used since it does not change the texture or
opearance of the specimen. The perfect treatment has yet to be found, how-
ver.

Several of the specimens had been misidentified and I thought you would
ike to know soon so I'm sending along a check list with your catalog numbers
ext to their identifications. If you have any questions about these deter-
inations I will be happy to answer them. I am impressed by the high number
f correct identifications you had made. Eventually we will send along a
ist of the specimens you sent with their OSUM catalog numbers but we need
ne dates of collection before we can start cataloging. I am enclosing a
erox copy of your list for this purpose. Day, month and year are ideal but
e can go ahead with only the year if detailed data is not available.

Under separate cover I am sending along several lots that you may find
f value in your work. If there are additional species you would like to
ave examples of please let me know which ones.

The specimen of F. flava (Rafinesque, 1820) you sent is rather unlike
nything I have seen of that species -- and we have hundreds of lots of this

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ery variable species here! If you ever have the opportunity to collect a ving specimen, or several if possible, I would like very much to be able examine the soft parts. They can be preserved entire by pegging the valves pen with small cork stoppers and dropping into AGW solution (80% ethanol, glycerine, 15% water). After a week or two they can be shipped moist in astic bags.

I didn't see Lampsilis rafinesqueana Frierson, 1927, in your list and curious as to its current status in your area. From what evidence I have, is uncommon species appears to be restricted to the Neosho River system of nsas, Missouri and Oklahoma. I have been unable to obtain specimens from kansas so far but haven't really collected that area as yet.

I am returning the unidentified specimen you sent earlier. It may well of value at some future point in your study. If at any time in the future u wish to deposit this valve or other voucher specimens here, such material most welcome. In any event I would encourage you to include it in your esis and the publication to follow. If at all possible, a photograph should included.

If I can help further, please let me know.

Sincerely,

David H. Stansbery
Director and Professor

HS/ds

nclosure

[illegible] from [illegible], Emporia, Kansas.

CTION NO. *Several* DATE *Received Jan. 1977*

ITY *Kansas*

~~CTOR(S)~~ *NOTE: Numbers are not OSUM numbers*

MARGARITIFERA Schumacher, 1816.
____ M. margaritifera form falcata (Gould, 1850).
____ M. hembeli (Conrad, 1838).
CUMBERLANDIA Ortmann, 1912.
____ C. monodonta (Say, 1829).
ANODONTA Lamarck, 1799.
____ A. imbecillis Say, 1829.
____ A. suborbiculata Say, 1831.
____ A. grandis grandis Say, 1829.
____ A. grandis corpulenta Cooper, 1834.
ANODONTOIDES Simpson, 1898.
____ A. ferussacianus (Lea, 1834).
STROPHITUS Rafinesque, 1820.
/1 S. undulatus undulatus (Say, 1817).
____ S. undulatus tennesseensis Frierson, 1927.
ALASMIDONTA Say, 1818.
____ A. marginata Say, 1818.
____ A. viridis (Rafinesque, 1820).
PEGIAS Simpson, 1900.
____ P. fabula (Lea, 1838).
ARCIDENS Simpson, 1900.
____ A. confragosus (Say, 1829).
ARKANSIA Ortmann and Walker, 1912.
____ A. wheeleri Ortmann and Walker, 1912.
SIMPSONAIAS Frierson, 1914.
____ S. ambigua (Say, 1825).
LASMIGONA Rafinesque, 1831.
29 L. complanata (Barnes, 1823).
____ L. costata (Rafinesque, 1820).
____ L. compressa (Lea, 1829).
____ L. subviridis (Conrad, 1835).
____ L. holstonia (Lea, 1838).
MEGALONAIAS Utterback, 1915.
67 M. nervosa (Rafinesque, 1820).
PLECTOMERUS Conrad, 1853.
____ P. dombeyana (Valenciennes, 1827).
TRITOGONIA Agassiz, 1852.
33 T. verrucosa (Rafinesque, 1820).
QUADRULA Rafinesque, 1820.
3/ Q. quadrula (Rafinesque, 1820).
____ Q. fragosa (Conrad, 1836).
____ ? Q. apiculata aspera (Lea, 1831).
____ Q. apiculata apiculata (Say, 1829).
____ Q. cylindrica cylindrica (Say, 1817).
____ Q. cylindrica strigillata (Wright, 1898).
70 Q. metanevra (Rafinesque, 1820).
____ Q. sparsa (Lea, 1841).
____ Q. intermedia (Conrad, 1836).
83 Q. nodulata (Rafinesque, 1820).
____ Q. mortoni (Conrad, 1836).
09 Q. pustulosa (Lea, 1831).
AMBLEMA Rafinesque, 1820.
02 A. plicata plicata (Say, 1817).
FUSCONAIA Simpson, 1900.
____ F. ebena (Lea, 1831).
____ F. subrotunda kirtlandiana (Lea, 1834).
____ F. subrotunda subrotunda (Lea, 1831).
____ F. subrotunda lesueuriana (Lea, 1840).
06 F. flava (Rafinesque, 1820).
____ F. cuneolus (Lea, 1840).
____ F. cor (Conrad, 1834).

FUSCONAIA (cont.)
____ F. barnesiana (Lea, 1838).
____ F. ozarkensis (Call, 1887).
____ ? F. askewi (Marsh, 1896).
CYCLONAIAS Pilsbry, 1922.
____ C. tuberculata (Rafinesque, 1820).
LEXINGTONIA Ortmann, 1914.
____ L. dolabelloides (Lea, 1840).
PLETHOBASUS Simpson, 1900.
____ P. cyphyus (Rafinesque, 1820).
____ P. cicatricosus (Say, 1829).
____ P. cooperianus (Lea, 1834).
PLEUROBEMA Rafinesque, 1820.
____ P. riddelli (Lea, 1861).
____ P. clava (Lamarck, 1819).
____ P. oviforme (Conrad, 1834).
____ P. coccineum (Conrad, 1836).
____ P. plenum (Lea, 1840).
____ P. cordatum (Rafinesque, 1820).
____ P. pyramidatum (Lea, 1831).
ELLIPTIO Rafinesque, 1820.
____ E. crassidens crassidens (Lamarck, 1819).
76072 E. dilatatus (Rafinesque, 1820).
HEMISTENA Rafinesque, 1820.
____ H. lata (Rafinesque, 1820).
UNIOMERUS Conrad, 1853.
76076, 76084 U. tetralasmus (Say, 1830).
____ U. declivis (Say, 1831).
PTYCHOBRANCHUS Simpson, 1900.
____ P. fasciolaris (Rafinesque, 1820).
____ P. subtentum (Say, 1825).
76079 P. occidentalis (Conrad, 1836).
OBLIQUARIA Rafinesque, 1820.
76039 O. reflexa Rafinesque, 1820.
CYPROGENIA Agassiz, 1852.
____ C. stegaria (Rafinesque, 1820).
____ C. aberti (Conrad, 1850).
DROMUS Simpson, 1900.
____ D. dromas (Lea, 1834).
GLEBULA Conrad, 1853.
____ G. rotundata (Lamarck, 1819).
ACTINONAIAS Fischer and Crosse, 1894.
____ A. ligamentina carinata (Barnes, 1823).
____ A. ligamentina ligamentina (Lamarck, 1819).
____ A. ligamentina ssp.
____ A. pectorosa (Conrad, 1834).
____ A. pleasi (Marsh, 1891).
____ A. ellipsiformis (Conrad, 1836).
PLAGIOLA Rafinesque, 1820.
____ P. lineolata (Rafinesque, 1820).
OBOVARIA Rafinesque, 1820.
____ O. olivaria (Rafinesque, 1820).
____ O. jacksoniana (Frierson, 1912).
____ O. subrotunda (Rafinesque, 1820).
____ O. retusa (Lamarck, 1819).
TRUNCILLA Rafinesque, 1820.
76005 T. truncata Rafinesque, 1820.
76036 T. donaciformis (Lea, 1827).
LEPTODEA Rafinesque, 1820.
____ L. leptodon (Rafinesque, 1820).
76043 L. fragilis (Rafinesque, 1820).

POTAMILUS Rafinesque, 1818.
P. alatus (Say, 1817).
48 P. purpuratus (Lamarck, 1819).
82 P. laevissimus (Lea, 1829).
P. capax (Green, 1832).

TOXOLASMA Rafinesque, 1831.
T. parvus (Barnes, 1823).
T. lividus lividus (Rafinesque, 1831).
T. lividus glans (Lea, 1831).
T. cylindrellus (Lea, 1868).
T. texasensis (Lea, 1857).

MEDIONIDUS Simpson, 1900.
M. conradicus (Lea, 1834).

LIGUMIA Swainson, 1840.
L. recta (Lamarck, 1819).
L. subrostrata (Say, 1831).

LEMIOX Rafinesque, 1831.
L. rimosus (Rafinesque, 1831).

VILLOSA Frierson, 1927.
V. fabalis (Lea, 1831).
V. trabalis (Conrad, 1834).
V. perpurpurea (Lea, 1861).
V. iris iris (Lea, 1829).
V. iris nebulosa (Conrad, 1834).
V. taeniata taeniata (Conrad, 1834).
V. taeniata punctata (Lea, 1865).
[redacted]
V. arkansasensis (Lea, 1862).
V. ortmanni (Walker, 1925).
V. vanuxemi (Lea, 1838).
V. lienosa lienosa (Conrad, 1834).

LAMPSILIS Rafinesque, 1820.
37 L. teres form teres (Rafinesque, 1820).
L. teres form fallaciosa (Smith, 1899).
? L. radiata radiata (Gmelin, 1791).
L. radiata luteola (Lamarck, 1819).
L. radiata hydiana (Lea, 1838).
? L. radiata claibornensis (Lea, 1838).
L. powelli (Lea, 1852).
L. virescens (Lea, 1858).
L. orbiculata (Hildreth, 1828).
L. higginsi (Lea, 1857).
L. rafinesqueana Frierson, 1927.
27 L. ventricosa (Barnes, 1823).
L. ovata (Say, 1817).
L. fasciola Rafinesque, 1820.
L. streckeri Frierson, 1927.
L. brevicula (Call, 1887).

EPIOBLASMA Rafinesque, 1831.
E. triquetra (Rafinesque, 1820).
E. arcaeformis (Lea, 1831).
E. brevidens (Lea, 1831).
E. haysiana (Lea, 1834).
E. sulcata sulcata (Lea, 1829).
E. sulcata perobliqua (Conrad, 1836).
E. lenior (Lea, 1843).
E. personata (Say, 1829).
E. flexuosa (Rafinesque, 1820).
E. lewisi (Walker, 1910).
E. stewardsoni (Lea, 1852).
E. biemarginata (Lea, 1857).
E. turgidula (Lea, 1858).
E. capsaeformis (Lea, 1834).
E. florentina florentina (Lea, 1857).
E. florentina curtisi (Utterback, 1915).
E. walkeri (Wilson and Clark, 1914).
E. sampsoni (Lea, 1861).
E. torulosa rangiana (Lea, 1839).
E. torulosa torulosa (Rafinesque, 1820).
E. torulosa gubernaculum (Reeve, 1865).
E. propinqua (Lea, 1857).

This list of Mississippi River System naiad species, subspecies and forms omits all undescribed taxa and is prepared for use in processing specimens at the Ohio State University Museum of Zoology.

D.H. Stansbery
Columbus, Ohio
January 1975

STATE BIOLOGICAL SURVEY OF KANSAS
THE UNIVERSITY OF KANSAS
2045 AVE. A, CAMPUS WEST
LAWRENCE, KANSAS 66044
PHONE 913-864-44

February 9, 1977

Mr. Joe Frazier
902 Lincoln
Emporia, Kansas 66801

Dear Mr. Frazier:

I have your letter of February 6, 1977 in which you ask about data concerning turbidity and temperature in the Neosho River system. I am sorry to inform you that some 12 years ago now, while I was in Venezuela, my mollusk collection, catalogues and notebooks were moved to the National Museum, Washington, D.C. A few notebooks were overlooked and I now have them — it is possible that some such data as you want may be among the field books. I'll try to find such information, but I am not hopeful. Neither have I had much success in extracting information from the National Museum. As far as I can learn, my collection is still in boxes, and I suppose so are the field notes, and hence unavailable.

Mr. Don Huggins and his assistants in the State Biological Survey, 2045 Ave. A, Campus West, Lawrence, Kansas 66044, have worked in the Neosho drainage and may have helpful data. Also, Dr. Frank Cross, Ichthyologist, Museum of Natural History, The University of Kansas, Lawrence, Kansas 66045, has worked extensively in the Neosho drainage system, and may have the kind of data you require. I assume, if such data can be found, that you would be able to come to Lawrence to transcribe them.

I trust that we may be able to assist you. You might want to compare the collections in the Biological Survey with your own, and I am sure that Mr. Huggins would like to know what kinds of unionids you have found. An exchange of specimens, as well as data, seems to me to be a strong possibility. In any event, we look forward to hearing from you again.

Very truly yours,

Byron Leonard

Byron Leonard

cc: Don Huggins
Frank Cross

THE UNIVERSITY OF KANSAS · LAWRENCE, KANSAS · 6604[illegible]

MUSEUM OF NATURAL HISTORY

24 March 1977

Mr. Joe Frazier
902 Lincoln
Emporia, Kansas 66801

Dear Mr. Frazier:

In response to your letter of March 15, I enclose 3 sheets of temperature data gleaned from James Deacon's field notes on the Neosho River in 1959. In some cases, Jim recorded turbidity in the form of Secchi disk readings. His station 11 was upstream from Council Grove, now inundated by the reservoir; station 12 was about a mile downstream from Neosho Falls; station 13 was just upstream from the highway 57 crossing near St. Paul (Neosho County). The records are limited, but I hope they will be of some help.

As an afterthought, I wish I'd had the student who pulled these data for me record air temperatures as well. If you need them, finding the differences more significant than absolute temperatures in your own data, we'll go back through the notes and add air temps. Let me know.

Sincerely,

Frank Cross

Frank B. Cross
Curator of Fishes

FBC/rk

THE OHIO STATE UNIVERSITY

20 April 1977

. Joe Frazier
2 Lincoln
poria, Kansas 66801

ar Mr. Frazier:

Your letter and the specimen it concerns have arrived. There are several oblems involved here and I shall make an attempt to outline and comment upon ch.

leurobema complex
The P/ cordatum (Raf., 1820)/should perhaps be termed the P. obliqua amarck, 1819) complex since the 1819 name has priority if it can be identi- ed from the type specimen or the original description. This has yet to be ttled to the satisfaction of all naiad workers. This complex, whatever the llid name, has at least six sibling species and most probably more. They are: cordatum (Raf., 1820), P. coccineum (Conrad, 1836), P. marshalli Frierson, 27, P. plenum (Lea, 1840), P. rubrum (Raf., 1820) and P. taitianum (Lea, 1834). e species most likely to be found in your area is P. coccineum. This species listed and figured for Kansas by Murray and Leonard (1962) on plates 15, 16, d 17 and by Scammon (1906) on plate 84, figure 1 (at least) and possibly plate , figure 2 and perhaps even plate 85, although the latter resembles P. rubrum re closely.

Not only do these species resemble each other superficially, P. coccineum n sometimes be all but impossible to separate from Fusconaia flava (Raf., 1820). the specimen in question is a female with soft parts the identification is ually a simple matter.

Comparing P. coccineum with F. flava:

P. coccineum	F. flava
- rounded outline	- triangulate outline
- heavier hinge teeth	- lighter hinge teeth
- females use outer gills only as marsupia	- females use both pairs of gills as marsupia
- ova white	- ova red
- nacre white, pink, salmon or cream	- nacre white or salmon
- umbonal cavity shallow	- umbonal cavity deeper

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ese two species overlap in all shell characters at various places throughout
e sympatric parts of their ranges. I believe there is good reason for this
t this does not help the shell identification problem!

My reason for the above discussion is that your sub-fossil specimen is not
early P. coccineum or F. flava but apparently one of the two. The shell char-
cters are somewhat closer to F. flava but I can easily understand how you arrived
P. coccineum. I am now more interested than ever to see the soft parts and
ells of F. flava from the Neosho River system.

I suggest that however you enter this record in your thesis and the pub-
shed paper to follow, that you note the uncertainty of the identification and
e possibilities. It is specimens like this one and the one you sent previously
at make research in naiadology a most interesting and challenging study.

I'm looking forward to the F. flava specimens on the way. The specimen in
nd and several of hopeful interest to you will soon be on their way back to you.

Sincerely,

David H. Stansbery

David H. Stansbery
Director and Professor

S/ds