

Kansas Pearly Mussel Newslines

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Venustaconcha in the Spring River are something special

Chris Barnhart, Southwest Missouri State University

The Kansas Pearly Mussel Newslines is published on an occasionally basis by the Kansas Dept. of Wildlife & Parks, and includes topics about freshwater mussels and other aquatic critters.

Brian K. Obermeyer, Editor
Edwin J. Miller, Associate Editor
Karen J. Couch, Illustrator

Venustaconcha means "charming or elegant shell" and it is an apt name for these pretty little unionids. It is common to find their

straw-colored shells, marked with bright green rays, along the banks of streams where they have been left by raccoons and muskrats. *Venustaconcha* are the most typical unionids in smaller upland streams of the Ozarks, where they are symbiotic with the darters and sculpins that host their glochidia larvae. In some spots in the upper reaches of the Spring River they are as common as 40 individuals per square meter.

Such an abundant mussel should be familiar, but the identity of Spring River *Venustaconcha* has been a matter of some uncertainty. Specimens have been referred to both as the ellipse (*V. ellipsiformis*), and Pleas' mussel (*V. pleasii*). The ellipse is widespread in the upper Mississippi drainage and northern Ozarks, whereas Pleas' mussel appears to be endemic to the White River system of the southern Ozarks. Recently, SMSU graduate student Frank Riusech undertook a genetic and morphological study of *Venustaconcha* from several sites around the Ozarks to try to determine their relationships in Missouri and Kansas (Riusech 1999).

Riusech found clear differences between Pleas' mussel and ellipse. Pleas' mussels are smaller than ellipse at similar age, and female Pleas' mussels have a distinct ventral indentation of the shell margin. Pleas' mussels also differ by usually having salmon-colored nacre and darker adult periostracum than ellipse. The Spring River *Venustaconcha* were more similar to ellipse from the Osage and Meramec systems than to Pleas' mussel. However, females from the Spring River were more cylindrical than other *ellipsiformis* populations, and Spring River mussels also usually lacked the rust colored cardinal and lateral teeth that are characteristic of ellipse from the Osage and Meramec river systems. Genetically, *pleasii* showed a 3.9% DNA sequence difference of the COI gene (commonly used for testing relatedness among species) when compared with ellipse from the Osage and Meramec systems. *Venustaconcha* from the Spring

River differed by 3.1% from *pleasii*, but also showed a sequence difference of 0.9-1.5% when compared to Osage and Meramec *ellipsiformis*.

The distribution of organisms can be used to infer past geologic events, and past events may likewise explain, "who lives where" today. The similarity of *Venustaconcha* in the Osage/Missouri and Spring/Neosho river systems suggests that, in the past, there was exchange of fauna between these drainages. Besides *Venustaconcha*, several fish also suggest this connection. For example, the gravel chub (*Erimystax x-punctatus*) occurs in both the Missouri and Neosho drainages, but not in the White River system, where the related Ozark chub (*Erimystax harryi*) is found. The rock bass (*Ambloplites ruprestis*) occurs in the north and west drainages, whereas the related Ozark bass (*Ambloplites constellatus*) is found in the White River system. The spotfin shiner (*Cyprinella spiloptera*) is found in the Missouri and Neosho basins but not in the White River system.

Geological evidence also supports historical connections between the Neosho and Missouri basins. The ancestral drainage patterns in eastern Kansas can be reconstructed from the distribution of chert gravel deposits that mark the paths of ancient stream channels. These deposits indicate that stream capture has occurred between the Neosho and Osage River systems during the past 2-24 million years. The ancestral Neosho system appears to have flowed further east before turning south, and its extent appears to have included a portion of the present day Marais des Cygnes (Osage/Missouri) basin (Aber 1997).

Although these shared species indicate historical connections, the Spring/Neosho river system has been isolated long enough to develop distinctive species that are found nowhere else on earth. These include the cardinal shiner (*Notropis cardinalis*), Neosho mucket mussel (*Lampsilis rafinesqueana*), and the Neosho midget crayfish (*Orconectes macrus*). Taxonomic opinions are an endless source of debate, and it is not yet clear whether the distinctions of Spring River *Venustaconcha* are sufficient to warrant a new species name. In the meanwhile, it is appropriate to refer to these mussels as *Venustaconcha ellipsiformis*, keeping in mind that there is interesting and in-

formative diversity hidden in a species name. The history and diversity of life on earth are a fascinating puzzle. Unfortunately, pieces of that puzzle are being lost at a frightening rate. Hopefully, we will recognize how unique and wonderful the faunas of our rivers are in time to save them.

Assessment of mussels on the Marais des Cygnes National Wildlife Refuge

Brian Obermeyer, *Stream & Prairie Research*

During summers 1999 and 2000, a preliminary mussel survey was conducted on the Marais des Cygnes National Wildlife Refuge, located in Linn County, Kansas. Three Marais des Cygnes River sites in riffle/run habitat were sampled, as well as an area of exposed mud flats along an abandoned mining pit called Turkeyfoot Lake. Sampling revealed the presence of 30 freshwater mussel species. Of these, 24 were found to be extant (21 live and 3 recently dead specimens), whereas six species were represented only by weathered shell material. Most of the mussels sampled in the survey were collected from the Marais des Cygnes River, but 13 species were found in Turkeyfoot Lake, including six species not found in the river.

The threeridge, *Amblema plicata*, was consistently the most abundant species in river collections; it was also common in Turkeyfoot Lake. Other species frequently collected in river habitats included the washboard (*Megaloniaias nervosa*), Wabash pigtoe (*Fusconaia flava*), pimpleback (*Quadrula pustulosa*), spike (*Elliptio dilatata*), pistolgrip (*Tritogonia verrucosa*), and fragile papershell (*Leptodea fragilis*). The most abundant species found in Turkeyfoot Lake included the flat floater (*Anodonta suborbiculata*), giant floater (*Pyganodon grandis*), pondmussel (*Ligumia subrostrata*), and lilliput (*Toxolasma parvus*). Among the mussels collected were two species new to the state of Kansas: spectaclecase (*Cumberlandia monodonta*) and purple wartyback (*Cycloniaias tuberculata*). The collection of fresh monkeyface (*Quadrula metanevra*) valves and live butterfly (*Ellipsaria lineolata*) specimens represent new species records in the Kansas portion of the Osage River system. The Asian clam (*Corbicula fluminea*), a non-native bivalve, was also collected at all of the sampling sites.

KDHE mussel Inventory

Bob Angelo, *KDHE*

The Kansas Department of Health and Environment has performed biological assessments of surface water quality on a routine basis since 1972. This work has

focused on the composition of stream macroinvertebrate assemblages and, since 1984, on the use of pollution tolerance scores and community-based metrics for characterizing stream condition. Unfortunately, freshwater mussels have rarely been represented in the department's quantitative invertebrate samples owing to their comparatively large size as adults, burrowing habits, and patchy distribution in many water bodies.

Departmental biologists recognized the diagnostic potential of mussels early on. In the early 1980's, they began to collect, label and store unweathered shell material encountered by chance during routine sampling operations. By 1990, they had implemented a standardized, qualitative procedure for determining the mussel taxa inhabiting a particular water body and for ascertaining major changes in the composition of the mussel community over time. This procedure included a systematic search for live mussels and the procurement of a representative collection of any unweathered, weathered or relic shell material.

The department's shell collection grew rapidly during the following decade and by January 2001 comprised some 5,000 specimens from more than 150 sampling locations. Each specimen was labeled with a unique archival number. This number was subsequently entered in an electronic database along with the associated genus and species, collection date, water body name, narrative and legal site description, length and height of specimen, condition of shell or valve (recent, weathered, relic), estimated relative abundance of species in historical or contemporary mussel assemblage (scarce, common, abundant), collector's name, and other information.

Although this database is chiefly intended to support the water quality assessment function of the department, it has proven useful to other agencies and organizations concerned with the preservation of mussels and the identification and protection of high quality streams. The data and collected shell material often are of interest to academicians and students engaged in mussel research. Surplus shell material has been used to upgrade the reference collections of other state and federal agencies and to create mussel exhibits for schools and various community organizations.

Access to the department's mussel database and shell collection, and copies of its written mussel sampling protocol, may be obtained by writing the Kansas Department Health and Environment, Bureau of Environmental Field Services, Forbes Field, Building 283, Topeka, KS 66620. Electronic mail should be directed to Bob Angelo at bangelo@kdhe.state.ks.us or Steve Cringan at scringan@kdhe.state.ks.us.

Kansas illustrator and mollusk authority, Karen Couch, assists USFWS in developing educational materials about rivers

Karen Couch, author of "An Illustrated Guide to the Unionid Mussels of Kansas", recently completed a contract with the endangered species field office of the U. S. Fish and Wildlife Service in Asheville, North Carolina. The project involved thirty illustrations of aquatic flora and fauna, including several freshwater mollusk species. Drawings were made of the fanshell, *Cyprogenia stegaria* (the eastern counterpart of our western fanshell, *Cyprogenia aberti*), Appalachian elktoe (*Alasmidonta raveneliana*), the oystermussel (*Epioblasma capsaeformis*), birdwing pearly-mussel (*Lemiox rimosus*), slabside pearlymussel (*Lexingtonia dolabelloides*), Alabama lampmussel (*Lampsilis virescens*), pale lilliput (*Toxolasma cylindrelus*), ring pink (*Obovaria retusa*), spiny river snail (*Io fluviatilis*), and several species of fish, mammals, birds, and plants. The illustrations will be used in the development of a series of river fact sheets as educational materials for public outreach.

Mussels along the Lower Walnut River, Cowley County, Kansas

Eugene A. Young, Natural Science Division, Cowley County Community College

Previous research has indicated that unionid mussel populations have declined throughout the Walnut River Basin since the early 1900's. Local flood control projects, dredging for gravel, the oil industry, and agricultural practices have all contributed to the decline of mussels during the last 100 years.

To understand the current population status of mussels along the lower Walnut River (from Winfield to the river's confluence with the Arkansas River at Arkansas City), four Cowley County Community College students began surveying mussels during fall 2000 to ascertain the status of populations, especially sites with stable gravel substrate. The project is being funded in part by the Kansas Department of Wildlife & Parks. Surveys will continue in 2001.

Stable gravel beds were not found along the Walnut River adjacent to Arkansas City where the only existing gravel beds are associated with bridges; even at these sites remnants of mussels were few. From the confluence of the Arkansas River upstream approximately 1.5 miles, the Walnut River was almost entirely silted, and no mussels were found. In Winfield, specimens collected and or observed (mostly relic and weathered) along the Tunnel Mill Dam and a site east of Interstate 77 produced records for

13 species (tentative identification). The only fresh (F) or live (L) specimens found were fragile papershell (F, L), pink papershell (F, L), pistolgrip (F, L), white heelsplitter (a F juv.), bleufer (F adult), and mapleleaf (F adult). Based upon shells observed at these sites, the threeridge and pimbleback were the most abundant species historically, whereas the plain pocketbook, yellow sandshell, threehorn wartyback were less common.

Our preliminary data supports Hacker's (1980) assertion that there has been a major shift in the lower Walnut River from thick-shelled lotic/erosional species to the thinner-shelled lentic/depositional species, caused primarily by increased siltation.

Army Corps of Engineers helps save stressed mussels in the Fall River

Last summer's hot and dry weather was very stressful to mussels. Fortunately, one area in Kansas was spared from a potential mussel kill because of fast action by the U.S. Army Corps of Engineers. Last August, abnormally high temperatures, lack of rain, and water extraction from irrigators and local municipalities had resulted in almost no flow in the Fall River, especially downstream from Fredonia (below Fall River Lake dam). In addition to the low flow conditions, dissolved oxygen was measured by KDWP in late August at only 4 mg/l. These conditions were very troubling since the Fall River holds one of the best freshwater mussel assemblages in Kansas, including the state endangered Neosho mucket and western fanshell and the threatened Ouachita kidneyshell.

After witnessing the stranding of mussels in the Marais des Cygnes River a week earlier (see Bruce Freske's article in this issue, on page 9), I contacted Cleon Linton (Kansas Area Lake Manager), Kenny Whitehead (Fall River Project Manager), and Everett Laney (Tulsa District Biologist) and asked if it would be possible for the COE to make an emergency release to sustain downstream mussels. Following consultations with Chris Mammoliti (KDWP) and the Kansas Water Office, the COE staff prudently began making additional releases from Fall River Lake. They first released an additional 25 cfs to "flush" the river, then began releasing 10 cfs (twice the normal low flow). The release helped alleviate the adverse stream conditions until the hot and dry weather pattern finally broke in October. I wish to commend the Tulsa District in helping to prevent a major mussel kill. — BKO

New web site about Kansas mussels

Jim Mason, Naturalist at the Great Plains Nature Center, has recently launched an excellent web site about Kansas mussel: <http://www.gpnc.org/unionid.htm>

Mussel survey conducted adjacent to a streambank stabilization project in the Neosho River, Allen County

Brian Obermeyer, Stream & Prairie Research

Baseline data regarding freshwater mussels was collected last summer in an approximate 730 m (2400 ft.) reach of the Neosho River in Allen County, Kansas, where eleven bendway rock weirs, designed by the U.S. Army Corps of Engineers to help reduce streambank erosion, were placed along a severely eroding bank. Both the bendway weir project and the mussel survey were funded by the Kansas State Conservation Commission and the Kansas Department of Health and Environment. Construction of the weirs was supervised by the State Conservation Commission.

During August 2000, three sampling reaches were quantitatively surveyed opposite of the newly placed rock weirs. A total of 160 m² quadrats were sampled within the three sampling reaches, with a total of 166 mussels of 14 species collected. In addition, extant representatives of eight additional mussel species (live or recently dead specimens) were collected outside of the quadrat samples. The only state listed T&E species collected alive in the study was the butterfly (*Ellipsaria lineolata*), although relatively recent shells of the Neosho mucket (*Lampsilis rafinesqueana*), rabbitsfoot (*Quadrula cylindrica*), and flutedshell (*Lasmigona costata*) were also recovered. Mussel density in the three sampling reaches was relatively low, with a mean of 1.04 per m² (SD = 1.20). Water depth where quadrat samples were taken ranged from 7 to 96 cm, with a mean depth of 42.0 cm (SD = 21.93), whereas the mean water depth where mussels were found was 47.02 cm (SD = 16.88). Quadrat samples in shallow habitat revealed few mussels, with only seven individuals collected from 32 near shore quadrats.

The anticipated reduction of channel migration by the placement of the bendway weirs at the project site may help stabilize instream sediments, which, in turn, could enhance mussel recruitment and the survival of juvenile and adult mussels. The weirs may also improve fish habitat, which could further improve the recruitment of mussels. The project site will be resampled at five-year intervals to evaluate possible impacts to mussels from the rock weirs.

KDWP mussel collections, 2000

Brian Obermeyer, Stream & Prairie Research

A total of 126 stream sites was sampled by three KDWP stream survey crews (LARB, GEMO, and REMAP) during summer 2000. The LARB (Lower Arkansas River Basin) stream team sampled 45 Arkansas River basin sites in 27 counties in south-central Kansas. The GEMO (Geomorphology) team gathered biological information at 36 sites adjacent to USGS stream gaging stations in 27 Kansas counties. The REMAP (Regional Environmental Monitoring and Assessment Program) survey team sampled 45 sites in 38 counties.

Mollusks were found at 42 of 45 LARB sites, but only 25 of

these sites revealed extant populations of unionid mussels. Nineteen freshwater mussel species were collected. Eighteen of these were represented by extant specimens, whereas one species, the deertoie (*Truncilla truncata*), was represented by a single subfossil valve. The mapleleaf, *Quadrula quadrula*, was collected alive at the largest number of LARB sites, followed by the pimpleback (*Quadrula pustulosa*) and giant floater (*Pyganodon grandis*). Other common extant species (including fresh and recent shells) were the fragile papershell (*Leptodea fragilis*) and pink papershell (*Potamilus ohioensis*). Fingernail clams were collected at 15 LARB sites. The Asian clam (*Corbicula fluminea*), a nonindigenous invader, was found at 17 LARB sites.

Stream team GEMO recovered bivalves at 32 of 36 sites. Thirty of these sites yielded unionid mussels, and 27 had extant representatives. A total of 27 unionid species were collected, eight of which were represented only by weathered or subfossil shells. Twenty-seven live mussels of 10 species were collected by KDWP personnel at 14 GEMO sites. Additional sampling of mussels was conducted by Stream & Prairie Research at site 081-GEMO-00, where 64 mussels of 14 species were collected. The most widespread extant species at GEMO sites was the fragile papershell, followed by the mapleleaf and pink papershell. Fingernail clams were collected at six GEMO sites. The Asian clam was found at 11 GEMO sites.

Bivalves were found at 30 of 45 REMAP sites. Unionid species were found at 28 REMAP sites, whereas only 18 sites revealed the presence of extant unionid populations. A total of 26 unionid species were recovered from REMAP sites. Seventeen of these had extant representatives. The giant floater was the most widespread extant species, followed by the pondmussel (*Ligumia subrostrata*) and fragile papershell. A total of 144 live mussels were collected at four sites; most of these came from site KRS-008-00 (Soldier Creek, Jackson County). Fingernail clams were collected at 13 sites. The Asian clam was found at nine sites.

Mussel surveys in Minnesota

Stephanie Sherraden, Emporia State University

Last summer (2000) I assisted the Minnesota Department of Natural Resources in conducting a statewide mussel survey. Two crews surveyed threatened and under-surveyed rivers throughout Minnesota to obtain baseline data on freshwater mussels. Sampling at each site consisted of at least 120 minutes of snorkel searches. The number of each species was sorted by age, and the largest and smallest specimen of each age category were measured. Funding for the project was provided by the Legislative Commission on Minnesota Resources Trust Fund through monies generated by the Minnesota State Lottery.

My crew spent the majority of the summer working in the St. Louis River Watershed. The fatmucket was the most common species we collected, followed by the black

sandshell and creek heelsplitter. The major rivers in this watershed were formed as glaciers melted in the late Pleistocene. The rivers are rocky and dark in color due to the presence of tannins. Water quality is generally very good, and the major fisheries consist of walleye, northern pike, and in some rivers smallmouth bass and trout. The watershed is heavily forested, with aspen, spruce, and jack pine the predominant tree species. The area was originally dominated by the white pine, but in the late 1800's extensive clear cutting of white pine was practiced throughout the watershed. "River drives" were common in many of the rivers, and we often found logs left behind from these river drives while conducting our surveys.

There are 49 species of freshwater mussels in Minnesota. Some of the most common species include the fatmucket, mapleleaf, white heelsplitter, and giant floater. Twenty-six of the states species are listed as endangered, threatened, or of special concern. Higgins eye, winged mapleleaf, yellow sandshell, and ebonyshell are some of the endangered species in the state. Commercial mussel harvesting is no longer allowed in Minnesota, however, weathered shells may be collected with a fishing license.

The zebra mussel is spreading throughout the Mississippi River and Lake Superior in Eastern Minnesota. During my last week of work, I sampled mussels in Lake Pepin, a natural widening of the Mississippi River in southeastern Minnesota. Zebra mussels are a big problem in the lake, and in some areas they are the dominant substrate. Native mussels in the lake were literally covered by a "mat" of zebra mussels, up to a foot deep in places.

Mussel survey planned in the old channel of the Neosho below St. Paul, Neosho County

Stephanie Sherraden, a graduate student at Emporia State University, plans to survey mussels this summer in an approximate 17 mile stretch of a side channel of the Neosho River south of St. Paul in Neosho County. Formerly the dominant channel of the Neosho River (until after the 1951 flood), the side channel is apparently destined to become an oxbow lake, with the likely result that native mussel species adapted to riverine conditions will perish. Isolation of this extensive river reach presents the unique opportunity to investigate and gather information on mussels in such a threatened habitat, as the river changes due to natural and manmade causes. A thorough inventory of freshwater mussels and the development of a contingency plan for mussels in this stream reach will be part of Stephanie's thesis.

Mussel news from the past

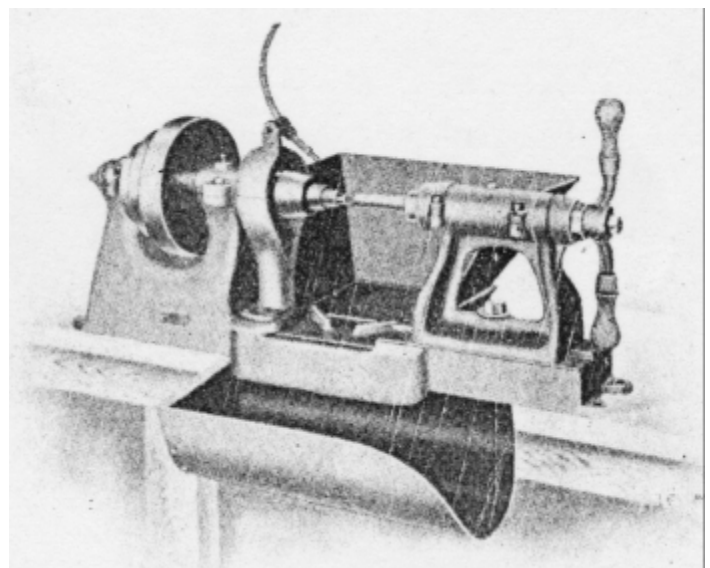
The button factory located here [Oswego] by the Tri-City Button Company, of Iowa, started six of their machines to reducing the immense piles of mussel shells in the rear of their building Wednesday morning. Eight more machines are equipped and ready to go as soon as the operators are broken in, making fourteen in all at present. All of the operators are new and it takes some little time to learn the ins and outs of getting the most from the shells in the minimum time and without breakage.

Each operator works on a commission, the shells being weighed in to him and the good buttons weighed out. A small circular file, propelled by a motor does the work and each workman stands all breakage to files. Each machine is equipped with a water service and a small stream of water play upon the file while it is cutting. The buttons are forced into a cylinder and into individual buckets below each machine. (See Figure below for an example of a simplified version of a cutting machine) Mr. Becker, who has charge of the plant here, states that the other eight machines will be placed in operation just as soon as the operators can be developed. Proficient operators make good money at it.

Since the location of the plant here mussel shells have been brought in from every direction. One man who has been working single handed just east of town, it is said, has been making from \$25 to \$40 per week most of the winter digging shells.

Percy Campbell, Wm. Freidel, Jasper Webb, Claude Clover, Earl Temple and H. Hinman, have machines at present and are rapidly mastering them.

—Taken from the *Oswego Independent*, Feb. 23, 1917



Phylogenetic study of *Cyprogenia aberti*

Jeanne Serb, University of Alabama

The western fanshell, *Cyprogenia aberti*, is a species of concern by the USFWS, and is endangered in Kansas. Because populations of *Cyprogenia* within the Arkansas, Ouachita, White, and St. Francis river systems have been geographically isolated from one another, they may represent discrete taxa. A phylogenetic analysis of 529 nucleotides of mt DNA from the first subunit of the cytochrome oxidase *c* gene (COI) was used to evaluate possible genetic partitioning of the populations. Preliminary results from this study indicate that *C. aberti* is not a monophyletic group, and may actually consist of multiple taxa. Populations of the Black River (Arkansas) are more closely related to *Cyprogenia stegaria* from the Clinch River (Tennessee) than to other populations of *C. aberti* in Kansas, Arkansas, or Missouri (Clade I). This relationship between *C. stegaria* and the Black River results in a non-monophyletic *C. aberti*. Genetic differences within Clade I average approximately 0.6%. The Black River/*C. stegaria* group (Clade I) is most closely related to *C. aberti* from the Arkansas River system (Clade II) and the Ouachita River system (Clade III). Populations of *C. aberti* sampled from the White River system (excluding the Black River) are the most basal group (Clade IV). Average genetic differences within clades II, III, and IV are 0.04%, 0.08%, and 2.0%, respectively. When comparing the Arkansas River system (Clade II) vs. clades I and III, genetic differences are over 2%.

Additional individuals from the same populations of the Caddo (Pike Co.) and Ouachita rivers, as well as a new locality on the Caddo River (Clark Co.), were also sampled. Inclusion of these individuals in the phylogenetic analysis does change the relationships among the clades. Specifically, these three individuals form a second Ouachita River clade that includes the White River specimen. Comparison of genetic differences between the two Ouachita groups (Clade III vs. three additional individuals) averages 8.8%. More data will be needed to determine the "realness" of this clade.

Phylogenetic study of *Ptychobranchnus*

Kevin Roe, University of Alabama

Despite increasing interest in North American unionid mussels, very few modern phylogenetic investigations have been conducted to date. Objective phylogenetic analyses have the potential to improve our understanding and estimates of biodiversity, provide the basis for improved classification schemes and are the basis for meaningful investigations into the behavior and ecology of unionid mussels. The following results represent preliminary

analyses of an ongoing research project investigating the systematics and zoogeography of the freshwater mussel genus *Ptychobranchnus* that I am conducting in collaboration with Kevin Cummings of the Illinois Natural History Survey.

Phylogenetic analysis of 1097 nucleotides of mt DNA indicate that the genus *Ptychobranchnus* is a monophyletic group. *Ptychobranchnus jonesi* (southern kidneyshell) is the most basal member of the group, followed by *P. subtentum* (fluted kidneyshell) and *P. greeni* (triangular kidneyshell) (Figure 1). The next most basal group is composed of *P. occidentalis* (Ouachita kidneyshell) from the Ouachita River drainage, which are sister to a large group that contains *P. occidentalis* from the White and Arkansas river (Spring and Verdigris rivers, KS) systems, plus *P. fasciolaris* (kidneyshell). *P. occidentalis* from the Ouachita drainage was distinct from other *P. occidentalis* populations, with genetic differences ranging from approximately 1.45% to 2.0%. These values are on the low side when compared to species level differences in *Ptychobranchnus* (e.g., *P. subtentum* vs. *P. fasciolaris* = 8.2%; *P. greeni* vs. *P. occidentalis* = 6.0%; *P. subtentum* vs. *P. occidentalis* = 9.0%; *P. jonesi* vs. *P. subtentum* = 9.0). However, differences between *P. fasciolaris* and *P. occidentalis* were on average only 2.25%!

I interpret these differences to mean that *P. occidentalis* and *P. fasciolaris* are only recently diverged from each other, probably towards the end the Pleistocene. Further analysis and the application of a molecular clock (if the data indicate this is reasonable) may find evidence that supports this, and could possibly tie the divergence of Ouachita *occidentalis* to the "creation" of the Arkansas River, which is hypothesized to have happened during the Pleistocene, sometime before the Sangamonian Age < 500,000 years ago. The upshot of all this is that it looks like some species are a lot younger than we had thought, while others may have diverged earlier, possibly during the Tertiary Period, although early Pleistocene is still feasible.

Sampling results from last summer s mussel workshop

Two stream sites were sampled for freshwater mussels last summer during the Y2K Kansas Pearly Mussel Workshop (11 August 2000). Ed Miller led a group to a Verdigris River site east of Sycamore in Montgomery County and Brian Foreman took a group to a Fall River site west of Fredonia in Wilson County. From the feedback Ed and I received, it seems that participants thoroughly enjoyed themselves. See tables below for results.

Site: Verdigris River, Montgomery Co., KS; GPS: N37.37036 W095.66892		
Landowners: Dan and Beth Small		
Collectors: S. Roth, D. Porter, Q. Phelps, E. Miller, T. Menard, T. Lyons, S. Lynott, B. Langley, G. Harris, B. Freske, S. Delano, D. Clarke, and T. Benenati; G. Young.		
Comments: This is the site where juvenile Neosho muckets were released in August 2000. Found 2 young western fanshells aged 3-4 years.		
Species		Live
Threeridge	<i>Amblema plicata</i>	x
Western fanshell	<i>Cyprogenia aberti</i>	x
Butterfly	<i>Ellipsaria lineolata</i>	x
Wabash pigtoe	<i>Fusconaia flava</i>	x
Plain pocketbook	<i>Lampsilis cardium</i>	x
Neosho mucket	<i>Lampsilis rafinesqueana</i>	W
Yellow sandshell	<i>Lampsilis teres</i>	x
White heelsplitter	<i>Lasmigona complanata</i>	x
Fragile papershell	<i>Leptodea fragilis</i>	x
Black sandshell	<i>Ligumia recta</i>	W
Washboard	<i>Megaloniaias nervosa</i>	x
Threehorn wartyback	<i>Obliquaria reflexa</i>	x
Round pigtoe	<i>Pleurobema sintoxia</i>	x
Pink papershell	<i>Potamilus alatus</i>	x
Bleufer	<i>Potamilus purpuratus</i>	x
Ouachita kidneyshell	<i>Ptychobranchus occidentalis</i>	x
Rabbitsfoot	<i>Quadrula cylindrica</i>	W
Monkeyface	<i>Quadrula metanevra</i>	x
Wartyback	<i>Quadrula nodulata</i>	x
Pimpleback	<i>Quadrula pustulosa</i>	x
Mapleleaf	<i>Quadrula quadrula</i>	x
Creepers	<i>Strophitus undulatus</i>	x
Pistolgrip	<i>Tritogonia verrucosa</i>	x
Fawnsfoot	<i>Truncilla donaciformis</i>	x
W = weathered shell material X = collected alive		

Site: Fall River, Wilson County, KS GPS: N37.52483 W095.91683		
Landowner: Bud Green		
Collectors: D. Martinez, N. Whitaker, M. Lowry, J. Dean, E. Johnson, T. Trotter, L. Knight, P. Balch, M. Combes, B. Busby, J. Tiemann, J. Deal, C. Cook, B. Obermeyer, K. Mitchell, K. Brunson, B. Foreman.		
Comments: Effort = 15 sq. m quadrats		
Species		No.
Pimpleback	<i>Quadrula pustulosa</i>	38
Wabash pigtoe	<i>Fusconaia flava</i>	24
Monkeyface	<i>Quadrula metanevra</i>	13
Threehorn wartyback	<i>Obliquaria reflexa</i>	6
fawnsfoot	<i>Truncilla donaciformis</i>	8
Threeridge	<i>Amblema plicata</i>	6
Mapleleaf	<i>Quadrula quadrula</i>	4
Plain pocketbook	<i>Lampsilis cardium</i>	3
Pistolgrip	<i>Tritogonia verrucosa</i>	3
Fragile papershell	<i>Leptodea fragilis</i>	2
Yellow sandshell	<i>Lampsilis teres</i>	1
Ouachita kidneyshell	<i>Ptychobranchus occidentalis</i>	1 outside quadrat
Paper pondshell	<i>Utterbackia imbecilis</i>	1 outside quadrat
Neosho mucket	<i>Lampsilis rafinesqueana</i>	W
Fat mucket	<i>Lampsilis siliquoidea</i>	W

Elktoe note

Edwin Miller, KDWP

On August 23, 2000, I assisted the USFWS madtom sampling crew at the Spring River site north of Old K-96 bridge. The crew consisted of Vernon Tabor, Dan Mulhern, Ken Collins (Tulsa USFWS office), Alex Cuman (KSU student) and myself. The Spring River fish fauna is diverse and interesting with its Ozarkian influence. Along with eight darter species, and interesting cyprinids like the spotfin and big eye shiner, one Neosho madtom was documented.

After kick-seining for fish along designated transects, we turned our attention to mussels. Unlike other Kansas mussel beds, Neosho muckets are the predominant species in this stretch of the Spring River. We also found other listed species such as the Ouachita kidneyshell, fluted shell, western fanshell, and ellipse. The find of the day was when Ken Collins held up a mussel with a large orange foot hanging out. It was a beautiful specimen of an elktoe (*Alasmidonta marginata*). After our initial awe subsided, the elktoe was photographed and replaced in the substrate (although Dan coveted the specimen). As an award for Ken's fine work and good luck, he was presented a bag of Vernon's homegrown chili peppers.

2000 mussel harvest

Tom D. Mosher, KDWP

The Kansas Department of Wildlife and Parks sold 33 mussel harvester and 1 mussel buyer permits during 2000. This was more than twice the number of permits sold during 1999, and reflects the optimism for higher demand and market value of shells. These higher markets, however, did not materialize.

Musselers harvested approximately 21,843 pounds of mussels in Kansas during 2000. This represented nearly a 29% decrease from 1999, despite the increase in permit sales. Harvest of mapleleaf (*Quadrula quadrula*) declined by 89%, threeridge (*Amblema plicata*) harvest decreased by 66%, and bleufer (*Potamilus purpuratus*) harvest decreased 15% from that reported in 1999. Only the monkeyface (*Quadrula metanevra*) was collected in greater numbers, with an increase of 76%.

The monkeyface was ranked first in total harvest last year. Ninety-three percent of the reported harvest of monkeyface shells came from the Neosho River. The threeridge was the second most collected species. Fifty-one percent of threeridge shells were taken from the Neosho River, with 16% harvested from the Verdigris River and 14% from the Elk River.

Preliminary survey of mussels in the lower Marmaton River, KS

Brian Obermeyer, *Stream & Prairie Research*

Last summer (August 24, 2000), Don George (KDWP Fisheries Biologist), Jim Bussone (KDWP Conservation Officer), and I conducted an informal survey of freshwater mussels in about a three mile reach of the lower Marmaton River in Bourbon County. We launched a canoe northeast of Fort Scott (approximately a 1/4 mi. downstream of Bridge 793) and exited the river at Slick Rock, a low water bridge crossing about 1.5 miles from the state line. During our canoe excursion, we sampled wherever it looked promising for mussels. We also examined gravel bars for weathered shell material to assess historic mussel populations. After our canoe trip, we crossed the state line and sampled above and below a bridge crossing in Vernon County, Missouri.

Much of the stream reach we canoed was deepwater habitat (avg. depth ~1.4 m), with lots of dead snags making canoeing very challenging. We found a really nice cobble riffle at an old bridge crossing (in the NW1/4 Sec. 21). However, the site was not particularly rich with live mussels. We found only 5 live individuals of 4 species, and a fresh shell of another (Live = mapleleaf, giant floater, fragile papershell, and pistolgrip; Fresh = yellow sandshell). The most interesting find at the site (for me at least) was a semi-weathered rock pocketbook (*Arcidens confragosus*) shell. This find, along with a more recent valve collected on the Missouri side a few days earlier by Don George, means that this state-threatened species may still occur in the Marmaton River. The second most exciting thing about this site was finding a crop of Marijuana, along with irrigation paraphernalia. The possibility of running into the owner of the illegal crop was a little creepy, but I thought we were safe since Jim was along—until he told us that he'd left his side-arm in the truck! I have never been so eager to leave a mussel sampling site.

Another creepy thing about this excursion was sampling in such nasty water. As you probably all remember, last August was incredibly hot and dry. The city of Fort Scott was siphoning the entire flow of the river to provide water for its thirsty citizens. As a result, the only flow of the Marmaton downstream of Fort Scott was the effluent coming from the Fort Scott waste water treatment facility; and everything in between (i.e., between the inflow and outflow pipes) was left high and dry. Don and I took our chances and waded in the "open sewer", whereas Jim was smart enough to wear waders. Unfortunately, Jim tripped and filled his waders, then had to wear sewage-soaked waders the rest of the day in 100-plus heat!

Water quality (determined by smell) and mussel composition seemed to get better as we proceeded downstream. About a half mile from Slick Rock, we found 13 mapleleaves, 3 threeridges, and 7 white heelsplitters in about a 15 minute search in run habitat. A few miles further downstream at the Vernon County bridge crossing we found live and/or recently dead specimens of 12 species: pink papershell, yellow sandshell, fawnsfoot, deertoe, threeridge, Wabash pigtoe, fragile papershell, mapleleaf, pistolgrip, white heelsplitter, pimpleback, giant floater. Weathered representatives from the 3-mile canoe trip plus the Vernon County site included the black sandshell, mucket, washboard, pondmussel, spike, and fatmucket.

Functional role of unionids in streams: comparative & experimental evidence from Ouachita Mountain rivers

Caryn C. Vaughn, Daniel E. Spooner, Melissa Moore and Keith B. Gido, *University of Oklahoma*

The freshwater mussel (Bivalvia: Unionidae) fauna of North American streams is the most diverse in the world, but is highly threatened and declining at an alarming rate. The consequences of this catastrophic decline of an entire family go beyond the loss of species, because mussels serve critical roles in the functioning of riverine ecosystems. Thus, the current decline in mussel species also represents a loss of critical habitat and food resources for the remaining aquatic fauna, and may alter the ecosystem functioning in many North American rivers. In addition, there are likely benthic macro- and microinvertebrates that have co-evolved with mussel assemblages, are specifically dependent on them, and thus may also be declining. The Ouachita Uplands in central and western Arkansas and southeastern Oklahoma represent one of the last strongholds of freshwater biodiversity in North America, and may represent one of the few areas where conservation of an intact mussel fauna may be possible.

We used laboratory experiments, a field experiment, and an ongoing field study to investigate the functional role of unionids in stream ecosystems. Laboratory experiments compared community respiration rates, water column nutrient concentrations, algal clearance rates, excretion rates, and biodeposition rates of *Actinonaias ligamentina* (mucket) and *Amblema plicata* (threeridge). Subtle differences in some species roles occurred at small spatial scales. However, there was a strong, linear relationship between unionid biomass and most ecosystem processes, regardless of species. A field experiment conducted in the Kiamichi River in the summer and fall of 2000 examined

colonization of benthic macroinvertebrates, periphyton, and bacteria in caged treatments of live *A. plicata*, live *A. ligamentina*, dead shells of each species, and a no-shell control. Data analyzed to date indicate that unionids do influence benthic communities, but that their influence is dependent on flow regime. For the past three years we have been quantitatively surveying mussels and associated benthic invertebrates and meiofauna (interstitial microinvertebrates such as copepods and nematodes) in the major river systems of the Ouachita Uplands. Environmental parameters are also measured at each site. We are only about half way through identifying and enumerating our invertebrate samples, but data analyzed to date indicate that densities of some benthic groups, notably oligochaete worms and filtering caddisflies, are significantly related to unionid density. Our results indicate that unionids can have strong effects on ecosystem processes when biomass is high, but that these effects are context dependent and can be overridden by physical forces.

Stranding of mussels during summer 2000 drought in the Marais des Cygnes River

Bruce Freske, Marais des Cygnes National Wildlife Refuge.

Extreme drought conditions and temperatures at or above 100 degrees late last August made it tough for mussels throughout Kansas. The lower Marais des Cygnes River was especially hard hit when a nearby power plant began pumping 35-50 cfs of water from a river with only 60 cfs. After further withdrawal from a downstream water district, the river at the Marais des Cygnes National Wildlife Refuge had less than 5 cfs of water. Some gravel sections had nearly no visible flows as the limited amount of water traveled underneath and through the gravel beds.

Brian Obermeyer and I visited a large mussel bed on the river on August 25th and were alarmed to find literally hundreds of mussels stranded, many of which were dead. Unfortunately, some of the species hit the hardest, those living on gravel riffles in fast flowing water, are also some of the rarest mussels in the Marais des Cygnes River; e.g., butterfly (*Ellipsaria lineolata*), round pigtoe (*Pleurobema sintoxia*), and purple wartyback (*Cyclonaias tuberculata*).

Shortly after leaving the river, the power plant was contacted and asked to discontinue pumping. They promptly agreed to turn off their pumps, which resulted in the river quickly rebounding to about 25 cfs, a level that likely allowed mussels in the remaining portions of the mussel beds to survive. Unfortunately, even this flow exposes a portion of some of the mussel beds. A level of at least 50 cfs would likely be needed to allow mussels to

utilize all of the available gravel substrate in the river.

Some good did come from the event, however, because the low water levels allowed us to discover a live purple wartyback, a new species for the state. In addition, a number of other unknown mussel beds were discovered, including a section of river three miles in length, which is nearly one continuous mussel bed. The water users and regulators also became aware of the mussel populations and their needs.

Perhaps most important of all, an understanding of how to handle water pumping during drought conditions was clarified. In the case of the power plant and water district, they both are in a water assurance district and thus own water in upstream reservoirs. They have the right to request this water during a drought and in fact the power plant must request this water if their pumping will reduce the river flow below 50 cfs, as the water district downstream needs flows of at least this level to meet water quality standards. Ironically, dams upstream, such as Melvern, Pomona, and Hillsdale, may provide us the best opportunity to help downstream mussel populations survive, perhaps even thrive, in the river.

The long term impact of the drought to the more uncommon mussel species will only be learned by future surveys. Although severe droughts have occurred throughout the history of the Marais des Cygnes River (e.g., the last similar event occurred in August of 1991), recruitment from downstream populations has been severely limited since the completion of Truman Dam in 1979. Downstream from the Refuge there are only about 9 miles of the river that has not been severely altered; i.e., much of the remaining downstream section has either been channelized by the Bates County Drainage Ditch or impounded by Truman Reservoir.

2001 Pearly Mussel Workshop

The 8th Kansas mussel workshop has been tentatively set for August 9 and 10, 2001. The first day of the workshop will be held at Emporia State University, and will include presentations about mussels and other aquatic topics. There will be a mussel identification session at the conclusion of presentations. On Friday, assuming weather and water levels cooperate, we plan to sample mussels at several stream sites in the upper Osage River system.

If you have a presentation you'd like to share at the August meeting, please contact Brian Obermeyer or Ed Miller. Be sure to let us know by June 1. A meeting agenda will be sent out in mid-June to those persons on the *KS Pearly Mussel Newsline* mailing list. We hope you all can make it!

Kansas Pearly Mussel Newsline
c/o Brian Obermeyer
Rt. 2 Box 141
Eureka, KS 67045

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C/O Brian Obermeyer
Stream & Prairie Research
Rt. 2 Box 141
Eureka, KS 67045
Phone: (316) 583-6096
Fax: (603) 794-5844
bko@eurekaerald.com

