

Distributional Revisions and New and Amended Occurrence Records for Prosobranch Snails in Kansas

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Gill-breathing operculate snails (Gastropoda: Prosobranchia) were reported historically from streams and wetlands throughout eastern Kansas. The past century has witnessed declines in the geographic range of most native taxa and the probable extirpation of at least two species, *Campeloma crassulum* and *Amnicola limosus*. Recent investigations have documented populations of five remaining prosobranch species. These include *Probythinella emarginata*, previously known in Kansas solely from the Pleistocene fossil record, and *Pleurocera acuta*, last reported in the state in 1956. *Cincinnatia integra* remains the most widely distributed prosobranch snail, occurring in scattered colonies throughout much of eastern Kansas. *Pomatiopsis lapidaria*, *Elimia potosiensis*, *P. emarginata*, and *P. acuta* are each relegated to a single known marsh or stream drainage. Earlier reports of *Campeloma decisum* in Kansas now are attributed to the conchologically similar species, *C. crassulum*. Changes observed in the prosobranch fauna during the past century have paralleled historical declines in habitat availability and surface water quality. The reversal of these environmental trends should serve as the initial focus of snail recovery efforts in Kansas.

INTRODUCTION

The freshwater prosobranch snails of Kansas have received intermittent investigation for nearly 120 years. Call (1885a; 1885b; 1886; 1887) published a series of reports on the Kansas molluscan fauna that listed six species of prosobranch snails, all confined in distribution to the eastern third of the state. Later records were obtained from intensive surveys of smaller geographical areas, such as Douglas County (Hanna, 1909), the Wakarusa River Valley (Franzen and Leonard, 1943), and the Spring River Basin (Branson, 1966). Similar efforts in Nebraska, Missouri, and Oklahoma effectively complemented the work in Kansas by providing records for locations immediately outside the state (Aughey, 1877; Sampson, 1913; Isely, as reported by Metcalf and Distler, 1984). Leonard (1959) published a handbook on Kansas gastropods containing life history notes, habitat descrip-

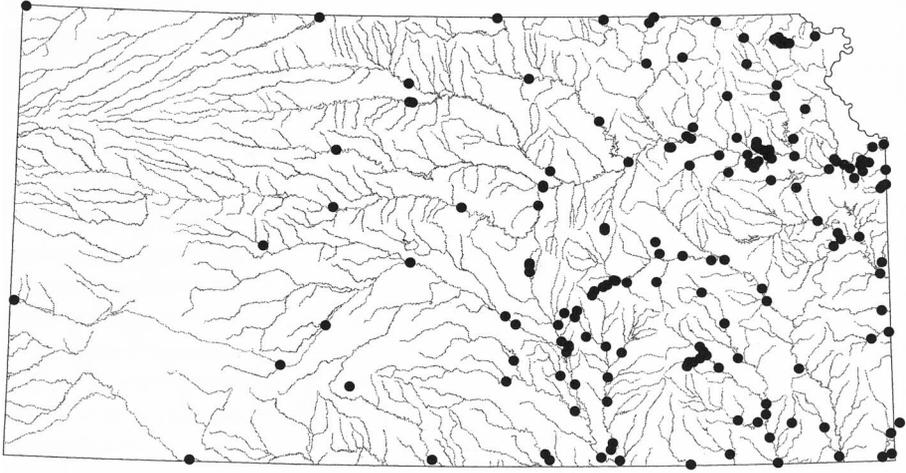


Figure 1. Map of Kansas depicting major streams and sites surveyed by KDHE for prosobranch snails from April 1980 to November 2001.

tions, and distributional records for 22 aquatic taxa, including five prosobranch species. His handbook continues to provide the most recent and comprehensive account for the state as a whole. Collectively, these early reports comprise an important series of benchmarks for evaluating historical changes in the native prosobranch assemblage.

Our paper addresses the recent occurrence and distribution of prosobranch snails in Kansas based on aquatic biological monitoring operations performed by the Kansas Department of Health and Environment (KDHE). Updated accounts are provided for all previously documented native taxa, and one species is reported from the state for the first time.

METHODS

Stream macroinvertebrate communities were surveyed at 178 locations in Kansas from April 1980 to November 2001 (Fig. 1). All but 37 sites were examined more than once during this period, and 93 sites were surveyed five times or more. Sampling protocols emphasized the number and types of specimens collected per unit time and permitted the examination of essentially all major stream habitats (KDHE, 2000). Snails and other organisms were collected manually or with D-frame nets and forceps. All specimens were preserved in 70–80% ethyl alcohol pending taxonomic examination. Qualitative surveys of selected streams, lakes, and wetlands also were performed during the summer and fall of 2001, focusing exclusively on the presence or absence of prosobranch gastropods. Newly encountered taxa and questionable specimens were submitted to the National Museum of Natural History for identification or verification. In compiling the quantitative and

qualitative survey data, snail taxonomic allocations at the ordinal level and below were based on Turgeon and others (1998).

SPECIES ACCOUNTS

Order Architaenioglossa

Family Viviparidae

Campeloma crassulum Rafinesque, 1819—The ponderous campeloma was reported originally in Kansas under the scientific name *Campeloma subsolidum*, with records from Soldier Creek (Shawnee County) and the Kansas, Missouri, Delaware, Wakarusa, Marmaton, Big Blue, and South Fork Big Nemaha rivers (Call, 1885a; 1885b; 1886; Hanna, 1909). In the early 1940s, an intensive two-year study of the Wakarusa River and surrounding watershed yielded only two dead shells of *C. crassulum* (Franzen and Leonard, 1943). Leonard (1959) concluded that this snail had been eliminated from the state sometime after 1930. Recent KDHE surveys have produced only weathered shells of this species from most of the previously named streams, in addition to Mill Creek (Wabaunsee County) and the Neosho, Vermillion, Black Vermillion, Marais des Cygnes, and Little Osage rivers. The nearest known extant colonies of *C. crassulum* occur some 200 km east of Kansas in south-central Missouri (Wu, Oesch, and Gordon, 1997).

Campeloma decisum (Say, 1817)—Although the Wakarusa River in Douglas County reportedly supported a large colony of the pointed campeloma about 1900 (Hanna, 1909), an intensive survey of this river in the early 1940s yielded no specimens (Franzen and Leonard, 1943). Recent KDHE surveys of the Wakarusa River in Shawnee County, upstream of Clinton Lake, likewise have failed to produce any live individuals or empty shells of this species. Aughey (1877) concluded that *Melantho decisa* (an early synonym for *C. decisum*) occurred throughout Nebraska. Dwight Isely reportedly collected *C. decisum* in 1911 from two streams in northeastern Oklahoma (Metcalf and Distler, 1984). A thriving population was reported later for Shoal Creek in southeastern Kansas (Branson, 1963), but recent KDHE surveys of this stream segment have provided no evidence of the pointed campeloma. Call (1894) indicated that earlier collections of *C. subsolidum* could be mistakenly allocated to *C. decisum*. Leonard (1959) did not explicitly list *C. decisum* among the state's native taxa, although he was aware of Hanna's work in Douglas County. Wu, Oesch, and Gordon (1997) concluded that the pointed campeloma was not an indigenous component of the Missouri gastropod fauna. Given this information, and in the apparent absence of any surviving voucher specimens or weathered shells from Kansas, we have concluded tentatively that the earlier reports of *C. decisum* in the state were based on occurrences of the conchologically similar species, *C. crassulum*.

Order Neotaenioglossa
Family Hydrobiidae

Amnicola limosus (Say, 1817)—The mud amnicola was reported first in Kansas under the scientific names *Amnicola limosa* and *A. porata*, with records from the Neosho River, Antelope Creek (Wabaunsee County), Cross Creek, and unspecified locations in Wabaunsee and Brown counties (Call, 1885a; 1885b; 1886). Hanna (1909) obtained only a single dead shell of this species from the Kansas River, and Leonard (1959) provided no subsequent records for this snail. Recent KDHE surveys have failed to produce any specimens of the mud amnicola. Although we have tentatively listed *A. limosus* among the state's extirpated mollusks, the recent discovery of this snail in neighboring Jackson County, Missouri (Wu, Oesch, and Gordon, 1997), suggests that isolated colonies may occur in northeastern Kansas.

Cincinnatia integra (Say, 1829)—Prior to the redescription of this species by Hershler and Thompson (1996), the midland siltsnail was known by an assortment of scientific synonyms, including *Paludina integra*, *Amnicola cincinnatiensis*, *A. scarboroughi*, *Cincinnatia cincinnatiensis*, and *A. integra* (e.g., Say, 1821; Call, 1885b; Hanna, 1909; Leonard, 1959; Metcalf and Distler, 1984). Early collection localities in the state included the Kansas and Neosho rivers, Shoal Creek, Vassar Creek (Shawnee County), Mud Creek (Douglas County), Silver Lake (an oxbow of the Kansas River in Shawnee County), Lone Star Lake (an impoundment in Douglas County), and an unspecified site near Onaga (Pottawatomie County) (Call, 1885b; Hanna, 1909; Leonard, 1959; Hershler and Thompson, 1996). Recent KDHE surveys have expanded the known range of this snail with collections from the Verdigris, Walnut, Republican, Fall, Smoky Hill, Cottonwood, and Little Arkansas rivers, the Blue River (Johnson County), Labette and Pottawatomie creeks, Cedar Creek (Johnson County), Wolf Creek (Coffey County), and Rock Creek (Cowley County). However, repeated surveys of the Kansas and Neosho rivers and Shoal Creek and a recent qualitative survey of Lone Star Lake have produced no specimens. The midland siltsnail may no longer occur in some of its former habitats in Kansas, but it remains the state's most widely distributed prosobranch species (Table 1; Fig. 2).

Probythinella emarginata (Küster, 1852)—Sediments deposited by the ancestral Smoky Hill River in McPherson County and the ancestral Cimarron River and Crooked Creek in Meade County have yielded numerous fossils of the delta hydrobe, formerly known by the scientific name *Probythinella lacustris* (Hibbard and Taylor, 1960; Miller, 1970; Hershler, 1996). Fossils of this snail also have been recovered from Pleistocene deposits along the Fall River in southeastern Kansas (B. Foreman, pers. comm., 2001). Although the delta hydrobe had not been associated previously with the contemporary fauna of Kansas, three live specimens were collected from Cedar

Table 1. Recent records for live prosobranch snails in Kansas and adjoining areas.

Species and water body	County	Latitude	Longitude	Year(s) collected
<i>Cincinnati integra</i>				
Blue River	Johnson	38.84233	-94.61247	1982, 1987-89, 1992-93
Cedar Creek	Johnson	38.89094	-94.88068	1980
Cottonwood River	Lyon	38.36582	-96.11486	1990
Fall River	Greenwood	37.64501	-96.06888	1982
Labette Creek	Labette	37.22995	-95.19750	1990
Little Arkansas River	Sedgwick	37.83215	-97.38802	1984
Pottawatomie Creek	Franklin	38.44058	-95.07472	1997
Republican River	Republic	39.99277	-97.93205	1995
Rock Creek	Cowley	37.42603	-97.00569	1991-92, 1994-95, 2001
Smoky Hill River	Ellsworth	38.72658	-98.23378	1995
Spring River	Jasper, MO	37.24555	-94.56648	1980
Verdigris River	Montgomery	37.32676	-95.68463	1996
Walnut River	Butler	37.58886	-97.00027	1983
Walnut River	Cowley	37.10686	-96.97742	1998
Wolf Creek	Coffey	38.16983	-95.69176	1987-88
<i>Probythinella emarginata</i>				
Cedar Creek	Chase	38.22370	-95.83128	2001
<i>Elimia potosiensis</i>				
Shoal Creek	Cherokee	37.04206	-94.64295	1982-84, 1990-93, 2001
Spring River	Cherokee	37.17868	-94.64152	1991, 1995-96, 1998, 2000
Spring River	Jasper, MO	37.24555	-94.56648	1980-81, 1984, 1986-89
<i>Pleurocera acuta</i>				
Marais des Cygnes River	Franklin	38.61132	-95.20639	1992, 1999, 2000
Pottawatomie Creek	Franklin	38.44058	-95.07472	2000-01
<i>Pomatopsis lapidaria</i>				
Muscotah Marsh	Atchison	39.75000	-95.51667	2001

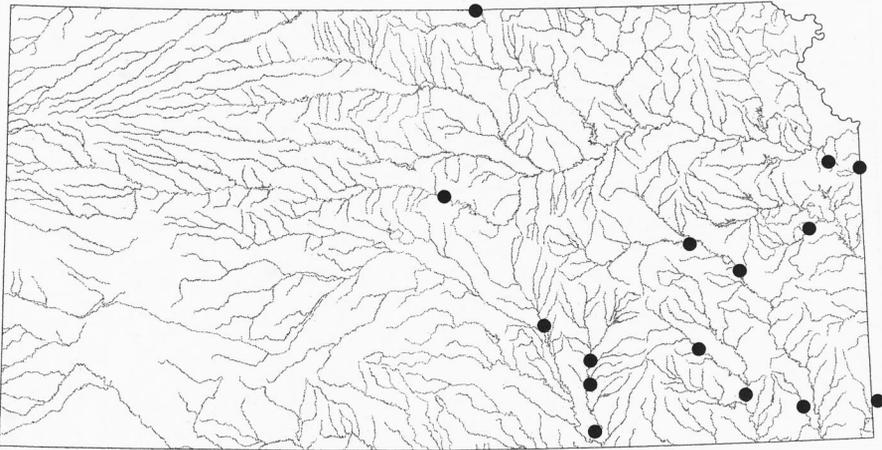


Figure 2. Survey sites yielding live *Cincinnatia integra* (Table 1).

Creek (Chase County) during a KDHE survey of this stream in June 2001 (Table 1; Fig. 3). Outside the state, the nearest recent locality for this snail is in Osage County, Missouri, approximately 400 km east of Cedar Creek (Wu, Oesch, and Gordon, 1997). Historical records also exist for central Oklahoma (Branson, 1959) and southeastern Nebraska (R. Hershler, pers. comm., 2002), but the current status of these populations is uncertain.

Family Pleuroceridae

Elimia potosiensis (I. Lea, 1841)—The pyramid elimia was reported originally from southeastern Cherokee County, Kansas, and adjacent areas of Oklahoma and Missouri under the scientific names *Goniobasis cubicoides*, *G. potosiensis plebeius*, *Mudalia plebia*, and *M. potosiensis* (Call, 1887; Franzen, 1944; Leonard, 1959; Jones and Branson, 1964; Branson, 1966). Call (1887) reported this snail from Five Mile Creek in Oklahoma, expressing confidence it would eventually be discovered in nearby Cherokee County. It later was reported by Franzen (1944) from an unnamed tributary of Shoal Creek in Kansas and by Branson (1966) from Shoal Creek in both Kansas and Missouri and the Spring River in Missouri. Recent KDHE surveys have documented this snail in the Kansas portion of the Spring River near Crestline but not below Empire Lake at Baxter Springs. Another population persists in Shoal Creek near Galena (Table 1; Fig. 3). Although its distribution in southeastern Cherokee County is somewhat fragmented, the pyramid elimia is regarded as the most commonly occurring snail in the drainage systems of the Ozark Plateau (Wu, Oesch, and Gordon, 1997).

Pleurocera acuta Rafinesque, 1831—Aughey (1877) reported three pleurocerid species from the Big Blue River in Nebraska; however, subsequent

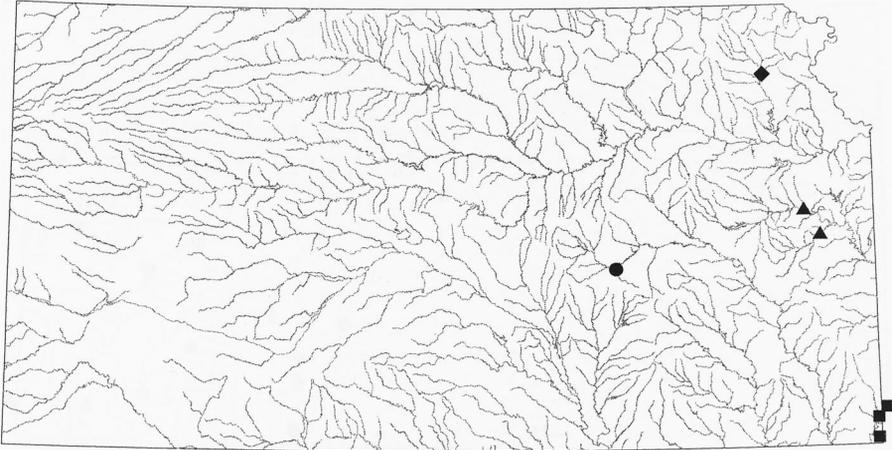


Figure 3. Survey sites yielding live *Probythinella emarginata* (●), *Elimia potosiensis* (■), *Pleurocera acuta* (▲), and *Pomatiopsis lapidaria* (◆) (Table 1).

workers attributed one of these records to the sharp hornsnail and the others probably to misidentifications (Goodrich, 1939; Metcalf, 1966). The sharp hornsnail was reported first in Kansas under the scientific names *Trypanostoma subulare* and *P. subulare*, with collections from the Marmaton River at Fort Scott and an unspecified location near Oswego (Call, 1885a; 1887). During the first half of the twentieth century, this snail also was observed in the Marais des Cygnes River between Ottawa and the Missouri state line (Franzen, 1944; W. Minckley, pers. comm., 1999). Leonard (1959) reported the sharp hornsnail from a site on the Walnut River near Augusta. Specimens labeled with this unprecedented location and a collection date of 11 April 1955 currently are archived in the National Museum of Natural History (R. Hershler, pers. comm., 1999). Metcalf (1966) documented the sharp hornsnail in the Marais des Cygnes River near Ottawa in 1956 but not in subsequent years. No additional occurrences were reported from Kansas until September 1992, when a single live specimen was collected during a KDHE survey of the Marais des Cygnes River in Franklin County. Additional specimens were collected from this location in August 1999 and September 2000. A second surviving colony was discovered in August 2000 in nearby Pottawatomie Creek, a major tributary of the Marais des Cygnes River (Table 1; Fig. 3). In recent years, repeated KDHE surveys of the Walnut, Marmaton, and Big Blue rivers have failed to produce any evidence of this snail. Owing largely to its documented decline and limited distribution in the state, the sharp hornsnail has been designated by the Kansas Department of Wildlife and Parks as a threatened species (Kansas Administrative Regulations (K.A.R.) 115-15-1 et seq.).

Family Pomatiopsidae

Pomatiopsis lapidaria (Say, 1817)—The slender walker was reported originally in Kansas in the early 1940s from an artesian marsh in south-western Atchison County (Franzen, 1944). Subsequent visits to this marsh by the Kansas Biological Survey in the early 1980s (Liechti, 1984) and by KDHE in July 2001 have confirmed the continued presence of this amphibious snail (Table 1; Fig. 3). No other extant colonies of *P. lapidaria* are known from Kansas, but a population has been discovered recently in neighboring Jackson County, Missouri (Wu, Oesch, and Gordon, 1997). The slender walker has been designated by the Kansas Department of Wildlife and Parks as an endangered species based on its limited distribution and general lack of supporting habitat in the state (K.A.R. 115-15-1 et seq.).

DISCUSSION

The streams and wetlands of eastern Kansas historically supported at least seven species of prosobranch snails, representing four families and two orders. Two of these species (*C. crassulum*, *A. limosus*) seemingly have been extirpated from the state, two others (*C. integra*, *E. potosiensis*) have been subjected to some degree of habitat fragmentation, and another (*P. acuta*) has undergone a significant reduction in range. The remaining taxa (*P. lapidaria*, *P. emarginata*) each are restricted to a single known location in Kansas. Overall, the native prosobranch snails have experienced a marked decline during the past century.

Earlier investigators were well aware of the changes occurring in this gastropod assemblage. Leonard (1959) compared his observations with those of Call (1885a; 1885b; 1886) and Hanna (1909) and acknowledged a reduction in the number of pleurocerid populations and the probable extirpation of *Campeloma*. He also discussed the general sensitivity of prosobranch snails to environmental degradation and attributed their demise to soil erosion, stream siltation, channel entrenchment, and the contamination of surface water with sewage and refuse from industrial facilities. Franzen and Leonard (1943) associated decreases in the abundance and diversity of aquatic gastropods with “the cutting of the woodlands, heavy grazing of the grassland, drainage of the [marshes], and extensive cultivation of the valley slopes.” Metcalf (1966) observed the apparent extirpation of one of the state’s last known colonies of pleurocerid snails following the onset of stream channelization, levee construction, and other flood control modifications upstream of the colony. Branson (1963) viewed the loss of native viviparid populations as simply “a sad commentary on farming and sewage disposal practices in Kansas.”

Recent decades have witnessed little additional change in the status of the native prosobranch fauna. Populations of pleurocerid and pomatiopsid snails

continue to persist at a few locations in the state but remain vulnerable to the threat of extirpation. An increase has occurred in the number of known hydrobiid colonies, but this may reflect the scope and intensity of recent sampling efforts rather than an actual extension in range. Although *C. crassulum* and *A. limosus* have not reestablished themselves within the borders of the state, no other prosobranch species has been added to the Kansas list of extirpated mollusks. State and federal programs for protecting the environment were expanded during the mid and late twentieth century (Jones, 1950; Foley, Smrha, and Metzler, 1955; KDHE, 1998). Concurrently, a number of major industries in eastern Kansas slowed or ceased production (oil fields, coal mines, lead and zinc mines, smelters) or moved their centers of operation to other areas of the state (large feedlots, packing plants). These developments reduced contaminant levels in some streams (Davis and Schumacher, 1992; Yu, Zou, and Whittemore, 1993; KDHE, 1996) and may have prevented or delayed the loss of certain prosobranch populations. However, localized improvements in water quality were not sufficient, by themselves, to stimulate a general resurgence in the diversity and distribution of these animals.

The current fragmented distribution of prosobranch snails in eastern Kansas is not attributable solely to human induced habitat loss and water pollution. Sporadic shifts in climate, evolving stream drainage patterns, and other natural (or formerly natural) phenomena also have influenced the development and decline of snail assemblages and other biological communities in this region (Williams, 1954; Metcalf, 1966; Miller, 1966; Cross, 1970; Wells and Stewart, 1987; Distler and Bleam, 1995). When Call began his investigations in the late nineteenth century, eastern Kansas represented the western distributional limit for each of the state's native prosobranch species. These initial surveys coincided with the end of an anomalous period of cooler weather and enhanced rainfall that began about 300 years earlier (Bryson, 1980; Kay, 1998). Leonard's work in the mid twentieth century followed the return of a less equable climate (cf., Martin and Martin, 1987) and the extended drought of the 1930s. The distributional boundary for at least two prosobranch species (*C. ponderosa*, *A. limosus*) already had receded eastward into Missouri, probably as a result of a combination of climatological and anthropogenic factors. The remaining prosobranch species were relegated to a few artesian marshes, spring-fed streams, or larger rivers generally resistant to dewatering and extreme fluctuations in temperature. During the past four decades, some of these aquatic systems have experienced major structural modifications or increased contaminant loadings and no longer support the prosobranch populations documented by Leonard. These recent losses underscore the biological importance and vulnerability of the state's remaining prosobranch habitats.

Ultimately, the continued survival of prosobranch snails in eastern Kansas

will require a general willingness on the part of society, and a specific commitment on the part of landowners and natural resource agencies, to protect the remaining colonies of these animals while working toward further improvements in water quality and the physical restoration of degraded streams and wetlands. Snail conservation and recovery efforts undoubtedly will face many challenges in the years to come, given recent climatological trends and the environmental and political pressures stemming from human population growth, urban and industrial development, and intensive agriculture.

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