TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCE
98(3–4), 1995, pp. 156–159

Decline in the Diversity of Bivalvia Ninnescah River, Kansas

DONALD A. DISTLER AND DANIEL E. BLEAM
Department of Biological Sciences, Wichita State University
Wichita, Kansas 67260-0026

At least 22 species of bivalve mollusks historically have occurred in the Ninnescah River Basin. Fifteen native unionacean species are extirpated and six exist in low numbers. The exotic species, *Corbicula fluminea*, is the most abundant and widespread bivalve in the system. Slow climatic changes from cool-moist to warm-dry following the last glacial period and rapid changes in stream regimen initiated by EuroAmerican settlement of the region in the 1880's are proposed as factors in this decline.

Call (1887) reported five species of Bivalvia inhabiting the North Fork of the Ninnescah River in Kansas. These species are recognized currently (Cummings and Mayer, 1992; Eberle, 1994) as *Utterbackia imbecillis, Quadrula pustulosa, Toxolasma parvus, Lampsilis teres,* and *Uniomerus tetralasmus.* Little attention since has been given to mussel assemblages in sandy rivers of the plains, perhaps because mussel diversity and numbers are low compared with streams in eastern Kansas, where shifting substrates are less common and the size of substrate particles are more heterogeneous. Beginning in 1983, with acquisition of property (Ninnescah Experimental Tract) along a one mile segment of the Ninnescah River (river-mile 56–57), we initiated studies on the distribution and abundance of aquatic organisms in this river. Although mile 56–57 received more intense surveys, the entire river received periodic attention, culminating in 1994 with data from 47 sites from the confluence of the Ninnescah and Arkansas Rivers upstream to Sylvia, Kansas, on the North Fork and to Cunningham, Kansas, on the South Fork. Above these sites, no shells or shell fragments were observed. This study reports on members of the freshwater families Unionidae (native) and Corbiculidae (introduced). Members of the family Spheriidae are not included.

The majority of bivalve material observed was worn valves and valve fragments. Valves could be assigned to 22 species: *Pyganodon grandis, Utterbackia imbecillis, Strophitus undulatus, Lasmigona complanata, Tritogonia verrucosa, Obovaria olivaria, Quadrula quadrula, Quadrula pustulosa, Amblema plicata, Fusconaia flava, Uniomerus tetralasmus, Truncilla donaciformis, Potamilus ohiensis, Potamilus purpuratus, Toxolasma parvus, Lampsilis teres, Lampsilis rafinesqueana, Lampsilis cardium, Lasmigona complanata, Leptodea fragilis, Ligumia subrostrata,* and *Corbicula fluminea*.

Of the 22 species observed, only 7 are extant. The exotic species, *Corbicula fluminea,* unobserved in mile 56–57 before 1986, now has spread throughout the main stem and lower North Fork. Below Cheney Reservoir it numbered 30 per square meter and in mile 56–57 about 1 per 100 square meters in 1994. It is the most abundant living bivalve in the river-system. *Potamilus ohiensis* and *Leptodea fragilis* are the only two native species extant in the sandy main stem, occurring in about a 9 to 1 ratio. The numbers of *P. ohiensis* average less than one per hectare (10,000 sq m). Fresh valves and living individuals of the following species occasionally may be seen in the confluences of silty tributaries and in small lentic habitats within the watershed: *Pyganodon grandis, Uniomerus tetralasmus, Utterbackia imbecillis, Toxalasma parvus,* and *Lasmigona complanata.* Charles Cope (pers. comm. 1995) observed fresh valves of *Ligumia subrostrata* in the North Fork above and below Cheney Reservoir in 1989. During a draw down (1992) of Lake Afton, a small recreational lake constructed in 1942 on a tributary (Clear Creek, Sedgwick County), we observed an abundant population of stranded *P. ohiensis* and *Q. quadrula.* Whether these two species were present in the system before impoundment, or were introduced later by stocking of sport fish carrying their glochidia, is unknown.

The remaining 12 species, as well as representatives of the thick shelled species mentioned, are present as subfossil valves or valve fragments. These valves are fragile, chalky, lack a periostracum and have a dull nacre. They seem to be eroded from sandy stream bank deposits and may be buried up to a meter in depth. After minor flooding, valve material occurs on depositional bars and islands. If tumbled too far, they may crumble and delaminate making identification all but impossible. Subfossil material is never abundant. *Potamilus ohiensis* and *L. fragilis* do not seem to be present in subfossil samples. Either the fragile nature of their shells enhances disintegration after excavation or either or both species have extended their ranges in the river system since EuroAmerican settlement. Theler (1990) proposes the latter explanation for the presence of *P. ohiensis* in the Missouri River of southwestern Iowa. According to Scammon (1906) *Obovaria olivaria* was abundant in the eastern Kansas River Basin in the early 1900's and had a preference for sandy rivers of moderate depth. It since has been extirpated from the state (Murray and Leonard, 1962). In Missouri it now occurs only in the Mississippi River above and below St. Louis (Oesch, 1984). Almost all the species present as subfossils in the Ninnescah River are declining in number and withdrawing in range eastward.

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Multiple factors may be responsible for this nearly 60 percent decline in the diversity of the mussel assemblage as well as a probable decline in numbers of the remaining species. Since the last major glaciation (approximately 18,000 to 14,000 BP) the climate of the plains has changed from cool-moist to warm-dry, and from taiga to semiarid steppe (Wells and Stewart, 1987).

More recently a cooling trend known as the Little Ice Age occurred from the thirteenth to the latter part of the nineteenth century. According to Bryson (1980) an era with 30 percent more rainfall than present ended on the Great Plains about 1883 when EuroAmericans were settling this region. Since development of agriculture in the watershed and construction in 1964 of a large water-supply reservoir (Cheney) on the North Fork, the channel of the river has entrenched more than a meter in depth. Tributaries, following the main stem, have cut down their channels. Although the Ninnescah River is considered a perennial stream with year-long flow, most of its tributaries demonstrate increased periods of intermittency or dry up completely. Such has been the situation of an unnamed eleven-kilometer tributary, the lower course of which traverses the Ninnescah Experimental Tract. This tributary has many complex meanders in its lowermost kilometer suggesting that in the recent past it was flowing at a higher, more permanent base level than at present. Currently it is rapidly incising these meanders. Within the past decade this tributary has dried up completely for periods of three to six months (1986, 1988, 1990–1991, 1994). Favorable habitat for mussels in these tributaries exists for insufficient time to allow for recolonization and maintenance of sexually mature individuals.

In addition, a gallery forest has developed along much of the main stem and lower tributaries since the early part of this century. This has tended to stabilize the stream width and direct the energy of flow to excavating the stream bed. Low-water crossings that were functional in the 1920's have been abandoned because of increased channel depths. Aggradation of streams beds followed the last glacial events only to be reversed to degradation shortly after EuroAmerican settlement.

Several traits in the life history of native mussels make them vulnerable to rapid habitat change: extended life spans, delayed maturity, low effective fecundity, limited powers of dispersal, poor juvenile survival, and long population turnover times (McMahon, 1991). Although native bivalves are declining in abundance and diversity throughout their ranges in North America, those inhabiting the rivers of the Great Plains are at the extreme western edge of their range and would be expected to decline as the climate became warmer and drier, but perhaps not as precipitously as they have in the present century. Juvenile recruitment among native bivalves is almost nonexistent at present and what we are witnessing are the dwindling numbers of long-lived adults destined for extirpation (McMahon, 1991). *Corbicula fluminea*

is well adapted to highly disturbed, unstable lotic habitats because of high growth rates, early maturity, high reproductive potential and the capacity for rapid downstream dispersal; hence, it can recover rapidly after catastrophic population declines (McMahon, 1991).

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