A REVIEW OF THE MUSSEL FAUNA OF THE NEW RIVER

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INTRODUCTION

The New River originates in the Blue Ridge Mountains near Blowing Rock, North Carolina (NC) and flows generally northward through Virginia (VA) into West Virginia (WV), eventually merging with the Gauley River to form the Kanawha River (Figure 1). The New-Kanawha River system is considered to be the oldest river system in the United States and one of the oldest in the world, occupying the same river channel established by the ancient Teays River. The Teays River was the largest river draining the Appalachians during the Tertiary period (Figure 2). Its original course was the same as that of the New-Kanawha until reaching a point 24 km below Charleston, WV. At this point the Teays deviated from the present Kanawha channel and flowed west to Huntington, WV, across Ohio to Wayne, Indiana and then west to Lincoln, Illinois where it was joined by the Mississippi River (Addair 1944). The present course of the New-Kanawha system differs from that of the Teays as a result of drainage changes associated with Pleistocene glaciation.

The extreme age of the New River basin makes this river unique among major rivers of the eastern United States. The river is characteristically montane with much of the relatively narrow channel consisting of bedrock, boulders, and large cobbles (Hocutt et al. 1978). The majority of the river in West Virginia flows through the New River Gorge, where it runs through a series of large rapids, cascades, and low falls. Less than 2.0 km downstream of its confluence with the Gauley River is the 7.3 m high Kanawha Falls. Such characteristics are uncommon for large river systems which usually exhibit a broad channel, mild gradient, and substrates composed primarily of smaller particle sizes. These prominent physical features of the New River have had a profound influence on the animal life of the basin, including its freshwater mussel fauna (Unionidae).

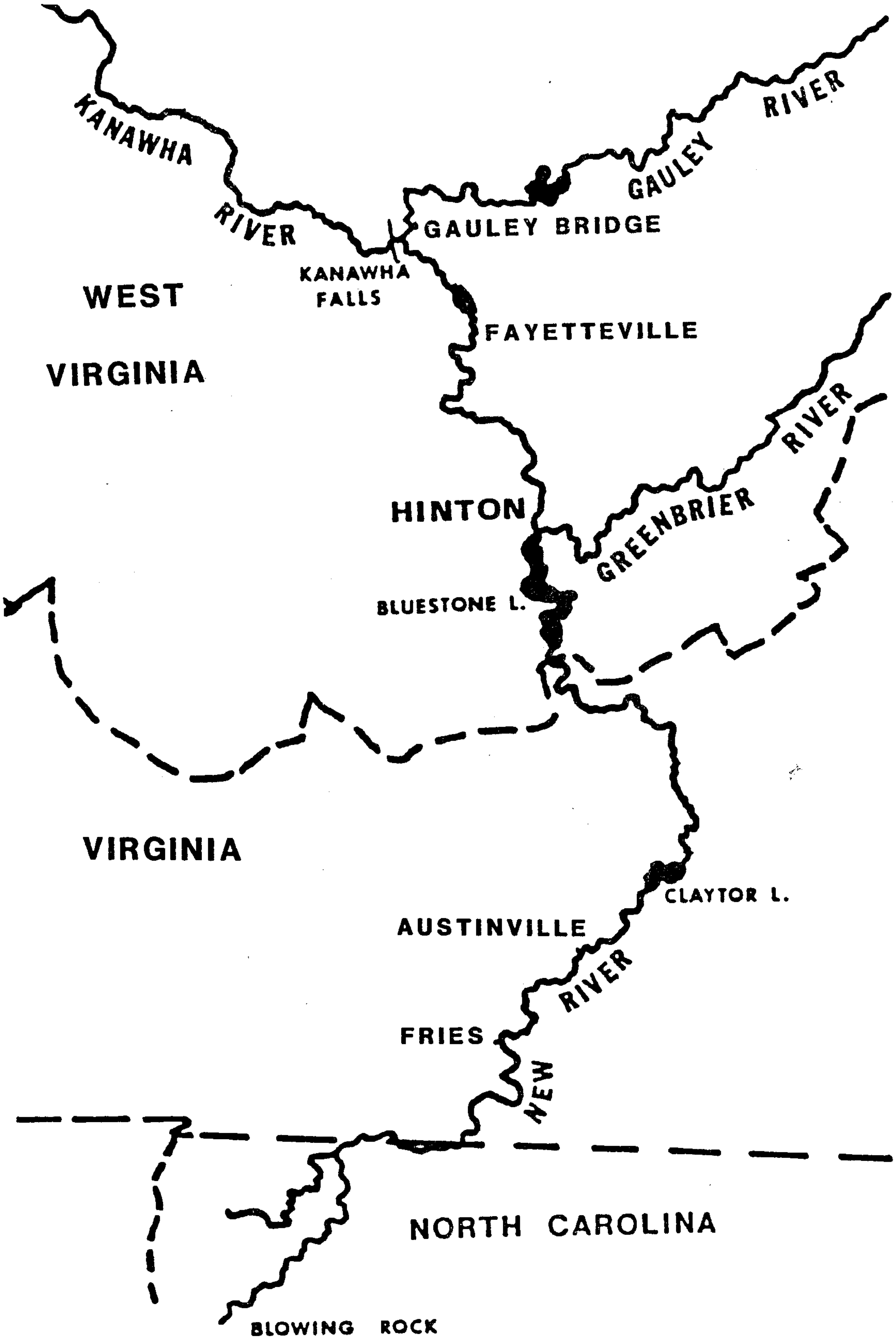
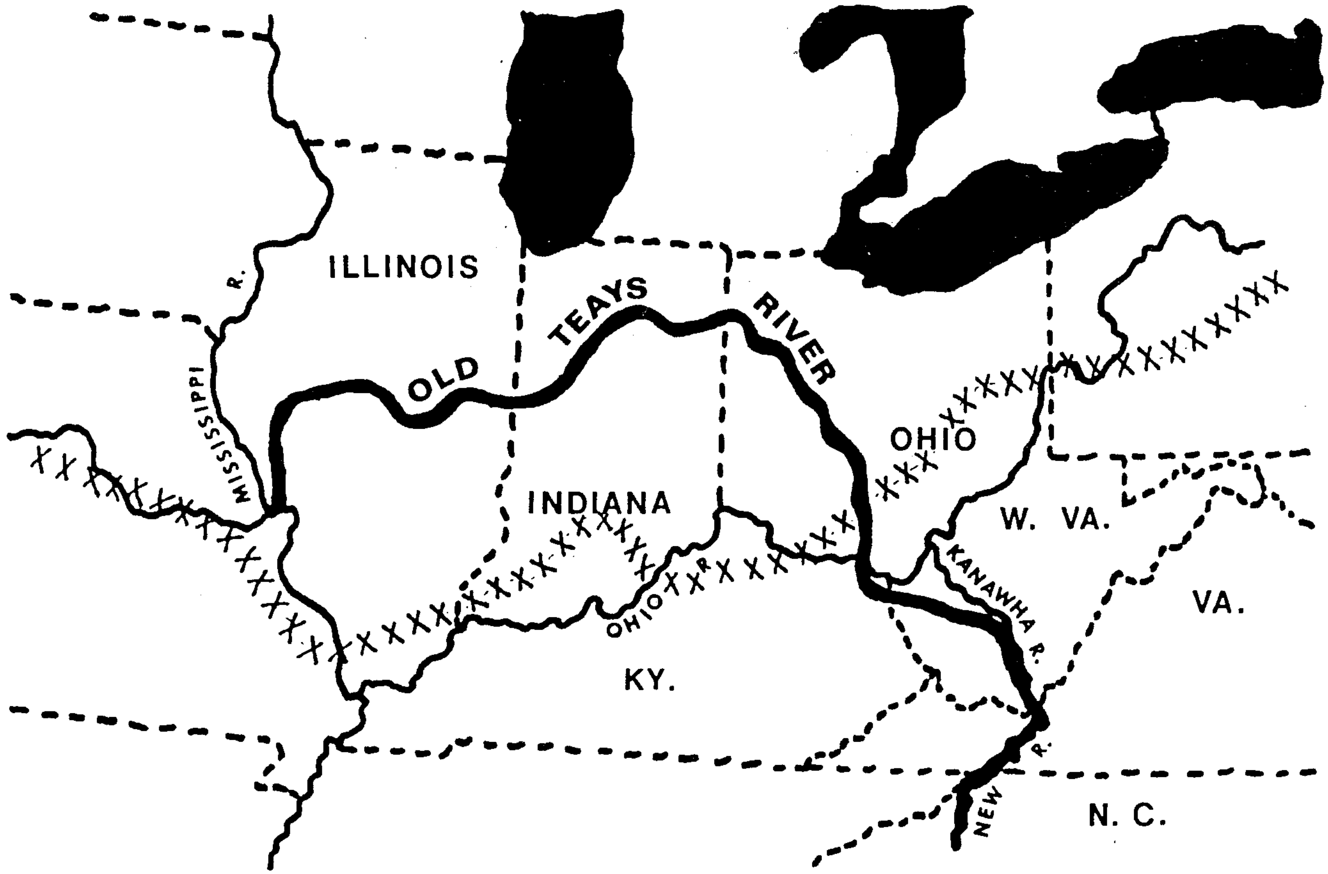


Figure 1. Map of the New River.



XXX - Southern limit of glaciation

Figure 2. Map of Teays River Channel.

MUSSEL FAUNA REVIEW

Interest in the mussel fauna (naiades) of the New River began shortly after 1900 when A. E. Ortmann began compiling information on the freshwater fauna of the Appalachian Mountains (Ortmann 1913). He reported a total of six species (Table 1) in the New River mainstem (Ortmann 1913; Ortmann 1919). The number of individuals of each species collected, as well as the number of collection sites and their locations were not reported, although reference is made to the area between Pearisburg, Giles Co., VA and Hinton, Summers Co., WV.

The next organized mussel investigation on the river was not conducted until 1969 when D.H. Stansbery from Ohio State University and W.J. Clench from Harvard University collected at six sites in the New River Gorge. Five of these sites were located between Bluestone Dam and Prince, Fayette Co., WV, with the sixth being located above Gauley Bridge, Fayette Co., WV. Nine species of mussels were recorded (Table 1) as well as the exotic Asiatic clam Corbicula fluminea (Ohio State University Museum, unpublished records). Only empty valves were found for Lasmigona subviridis, Cyclonaias tuberculata and Lampsilis fasciola, but at least one live specimen was collected for each of the remaining six species. The collection of Toxolasma parvus at the site near Gauley Bridge represents the only known record of this species in the New River drainage.

In 1970 biologists at the Center for Aquatic Biology, Eastern Michigan University collected mussels from two sites in the New River, West Virginia as part of a state-wide mussel survey (Bates 1979). The first site was located below Bluestone Dam, and the second site was below Sandstone Falls. No mussels were collected from the site below the dam, but six species were collected alive from below Sandstone Falls (Table 1). All of these species were previously recorded in earlier surveys except Quadrula quadrula. There is some question as to whether this species was correctly identified since no other record (historic or recent) of it exists in the New drainage. This species is more typical of large, slow-flowing rivers containing finer substrates than those found in the New River.

A survey of the river's molluscan fauna in Virginia and North Carolina was made in 1976 (Dillon 1977). Eighteen stations were sampled with ten sites located on the mainstem between Grayson and Montgomery Counties in Virginia and four additional sites in each of the North and South Forks in Ashe and Watauga Counties, NC. Six species of mussels were identified with all but L. subviridis and Alasmidonta marginata being considered common at one or more sites (Table 1). No mussels were collected at sites in the North Fork, and only Elliptio dilatata was collected from two sites on the South Fork. L. subviridis was reported as far upstream as 4.3 km below Fries, Grayson Co., VA. C. tuberculata and A. marginata were found as far upstream as Fries. Tritogonia verrucosa and Lampsilis ovata ventricosa were

Table 1. Summary of Surveys and Collection Records of Mussels in the New River.

Species	Ortmann 1913,1919	Stansbery/Clench 1969	Bates 1979	Dillon 1977	Markham et al. 1980	Neves 1978-81	USFWS 1984	Jirka 1984
Actinonaias carinata	X	X	X		X			X
Alasmidonta marginata	X			X				X
Anodonta grandis		X				X		
Cyclonaias tuberculata	X	X	X	X	X	X	X	X
Elliptio dilatata	X	X	X	X	X	X	X	X
Lampsilis fasciola		X				X	X	X
L. ovata ventricosa		X	X	X	X	X	X	X
Lasmigona subviridis	X	X		X		X		
Quadrula quadrula			X*					
Toxolasma parvus		X						
Tritogonia verrucosa	X	X	X	X	X	X	X	X

* Occurrence of this species is questionable.

found no further upstream than Powder Mill Branch near Ivanhoe, Wythe Co., VA.

In 1979 the Appalachian Environmental Laboratory, University of Maryland conducted a survey of the New River mussel fauna in Virginia and West Virginia (Markham et al. 1980). Eleven localities between Glen Lyn, Giles Co., VA and Meadow Creek, Summers Co., WV were sampled with six of these sites located downstream of Bluestone Dam in the New River Gorge. Five mussel species and C. fluminea were reported, all of which had been reported previously (Table 1). C. tuberculata was the most common unionid collected.

The junior author made periodic collections of unionids in the New River in Virginia and West Virginia from 1978 to 1981. Ten sites were collected between Austinville, Wythe Co., VA and Hinton, Summers Co., WV with seven species being identified (Table 1). All species were collected alive from at least one station and had been reported previously from other parts of the river. The collection of Anodonta grandis from Claytor Lake represents the farthest upstream record of this species, as does the collection of L. fasciola in the New River near Austinville. A. grandis probably did not occur naturally in the New River since it characteristically inhabits slow-moving or lentic waters. Its presence in Claytor Lake and near Bluestone Lake, where it was also collected, is probably due to incidental introduction via stocking of fishes infested with the larvae (glochidia) of this relatively ubiquitous species.

An investigation of the naiad fauna of the New River from the Wylie Islands complex, Monroe Co., WV to the mouth of Indian Creek, Summers Co., WV was conducted by the U.S. Fish and Wildlife Service in 1983 (USFWS 1984). Five mussel species were collected along with C. fluminea (Table 1). C. tuberculata was considered the dominant unionid species in this stretch of river followed by L. o. ventricosa.

In June 1984, the senior author began a mussel survey of the New River Gorge National River as part of a faunal inventory being conducted for the National Park Service by the Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University. The 52-mile reach of river between Hinton, Summers Co., WV and Fayetteville, Fayette Co., WV (Figure 1) was floated by raft, and sites containing suitable mussel habitat were qualitatively sampled by handpicking, use of waterscopes, and snorkeling. The farthest downstream sampling site was located approximately 1.5 km above Keeney Creek, Fayette Co., WV, but no mussels, live or dead, were collected downstream of the abandoned town of Beury. The lack of suitable substrate and the high current velocity below this point apparently preclude mussel colonization. Seven mussel species, plus C. fluminea, were identified within the Park boundaries (Table 1). All species were collected alive from two or more sites. A. carinata was by far the dominant unionid, being found in relatively high densities throughout the survey area. _C. fluminea_ was also extremely abundant throughout the Gorge and was usually present wherever unionids were collected. The farthest downstream record of live mussels was near the town of Beury where _A. carinata_, _E. dilatata_, and _C. tuberculata_ were collected. In general, mussels were abundant throughout the first several miles of river below Bluestone Dam. Abundance gradually declined downstream with distributions becoming more clumped than in the upper reaches of the Gorge.

A total of eleven species of freshwater mussels have been reported from the New River. Seven of these species can be considered common in at least some sections of the river. Of the remaining four species, _T. parvus_ has been collected only once, and the record of _Q. quadrula_ is considered questionable. _L. subviridis_ and _A. marginata_ are considered uncommon and have been collected infrequently from the New River mainstem. Four additional unionid species have been reported from waters contiguous with the New River. _Villosa iris iris_ was collected from the Bluestone River, Summers Co., WV (USFWS 1984), and _Lasmigona costata_, _Obovaria subrotunda_, and the federally endangered _Lampsilis orbiculata_ have been reported as occurring in the Kanawha River above Kanawha Falls (Taylor 1983). It is conceivable that these species may also occur within the lower New River but no records are available.

FACTORS AFFECTING DIVERSITY

The naiad fauna of the New River is strikingly depauperate when compared to the high diversity (34 species) presently found in the Kanawha River (Stansbery 1980; Clarke 1982; Taylor 1983). This relatively low species diversity has been the subject of much speculation among malacologists since the size, age, and geographic location of the New River suggest that it should have a more speciose mussel assemblage. Many hypotheses have been presented to explain the lack of species diversity in the river, although none have been substantiated. Most of these hypotheses attempt to explain the river's low fish species diversity, but the reasoning is also applicable to mussels whose glochidia are obligate parasites on the gills and fins of fish that serve as dispersal agents.

The present distribution of fauna in the New River is closely linked to the geologic history of the Teays River, particularly events occurring during Pleistocene times. This period was characterized by major climatic changes in North America associated with alternating glacial and interglacial periods. Prior to this time, the Teays River served as a corridor for the dispersal of fauna eastward, and its fish and mussel fauna was probably similar to that presently found in the Kanawha River (Neves 1983). During periods of glaciation the climate of the southern Appalachians was cold and dry, resulting in low water temperatures in periglacial rivers such as the

Teays. The harsh environmental conditions during glaciation undoubtedly led to extirpation or displacement of many cold-intolerant aquatic species southward into more hospitable environments. The lack of physical barriers between southern tributaries allowed for rapid emigration of faunal groups and their subsequent recolonization of the lower Teays during interglacial times (Brooks 1971). It is probable that some mussel species inhabiting the Teays during interglacial periods died out during glacial periods as a result of extirpation of their fish hosts or unsuitable water temperatures for reproduction (Neves 1983). Jenkins (1970) contended that the New River once harbored a rich sucker fauna that eventually disappeared from the drainage. If this is true, then it is likely that some mussel species also were lost.

Aside from the climatic changes during the Pleistocene, other physical forces associated with glaciation may have limited mussel recolonization of the upper Teays (New River). During glacial periods considerably greater discharge occurred in the upper Teays drainage, serving to scour the river bed and cut its channel deeper. This contributed to the steep gradient, rugged substrate, and the creation of falls, including Kanawha Falls, found throughout the river today. The high discharge and strong current, paucity of suitable substrate, and physical barriers all served to inhibit the reinvasion of many mussel species into the upper Teays following the retreat of the last glaciers. Kanawha Falls in particular has probably been one of the most limiting factors to recolonization, considering the high diversity of mussels immediately below the falls. Some species were probably able to circumvent the falls and parts of the lower New River Gorge via their fish hosts during periods of prolonged flooding caused by glacier-induced impoundment of the Teays (Neves 1983). The other species present in the New River today probably survived in the upper reaches of the Teays during glacial periods.

Another process occurring prior to the Pleistocene was the capture of streams from the western slopes of the Appalachians by Atlantic slope streams. Stream capture is the diversion of water from a stream into the drainage of a pirate stream as a result of encroachment by the pirating stream through active erosion. Because of differences in rock strata and erosion rates between Atlantic slope streams and western slope drainages, Atlantic slope drainages were able to spread westward and capture westwardly draining waters (Hocutt et al. 1978). These captures had the effect of reducing the New drainage basin in size, resulting in not only a loss of surface flow in the upper basin, but also a loss of habitat diversity provided by major tributaries (Addair 1944). The New River is strongly lacking in major tributaries considering its length, and the probable loss of tributaries through stream captures has reduced the number of avenues for invasion of new species into the mainstem.

Several other factors have been cited as possibly limiting species diversity of mussels and other fauna in the New River. It has been suggested that water chemistry parameters, particularly calcium content, may serve to exclude some species from inhabiting parts of the river basin (Dillon 1977). High sulfate concentrations, resulting from weathering of metamorphic rock formations, may have limited the fish fauna and in turn mussel diversity (Ross and Perkins 1959). Hocutt et al. (1978) listed the general lack of aquatic vegetation, poorly developed floodplains, and environmental degradation as factors limiting to faunal development. It is also possible that anthropogenic activities such as logging, mining, and dam construction have eliminated some mussel species that existed only in small numbers prior to settlement of the area (Addair 1944). Practices such as these were widespread in the New River drainage in the past and still occur in some areas today. Although these other factors may have had an effect on the mussel fauna of the New River, we believe that the influences of Pleistocene glaciation and the prominent physical features of the drainage, notably Kanawha Falls, have been the main forces restricting species diversity in the New River today.

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