

**NONMARINE MOLLUSCA IN THE UPPER TRIASSIC CHINLE
FORMATION AND RELATED STRATA OF THE WESTERN INTERIOR:
SYSTEMATICS AND DISTRIBUTION**

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Abstract - Abundant, widespread freshwater molluscs have been reported from Upper Triassic continental strata for over 100 years. Systematics are in need revision, with older studies consisting of description of species from isolated localities with no attempt to document ecophenotypic variation or geographic and stratigraphic ranges. Taphonomic analyses must precede paleoecologic interpretations, and the present study has discriminated several types of assemblages. The most common accumulations of freshwater molluscs occur as "transported" assemblages deposited in crevasse splays. Other types of assemblages include "transported" and "in-place" assemblages in channel deposits, and "disturbed neighborhood" assemblages in floodplain ponds. The unique adaptations of freshwater molluscs, such as the parasitic glochidial larvae of unionid bivalves, may provide a tool for understanding drainage patterns and dispersal routes between Upper Triassic depositional basins.

INTRODUCTION

The Upper Triassic continental strata of the Western Interior of the United States contains abundant, widespread nonmarine molluscs. These include two genera of prosobranch gastropods and three genera of unionid bivalves (Table 1). The unionids represent the oldest, unquestioned occurrence of the modern Superfamily Unionacea. The goals of this paper are to: (1) summarize the current state of the systematics of these bivalves and gastropods, (2) discuss the stratigraphic and geographic distribution of Late Triassic nonmarine molluscs, (3) discuss the general taphonomic patterns of mollusc assemblages and the paleoenvironmental significance of these mollusc occurrences and (4) suggest some future potential of molluscs to the understanding of biogeography and paleoecology of the Chinle Formation and equivalent strata.

SYSTEMATICS OF LATE TRIASSIC NONMARINE MOLLUSCS

The Late Triassic nonmarine molluscs are in need of systematic revision. Work to date has involved description of

TABLE 1. Late Triassic freshwater mollusc taxa from the western U.S.

Class Bivalvia	
Subclass Lamellibranchia	
Order Schizodonta	
Superfamily Unionacea	
Family Unionidae	
Subfamily Hyriinae	
<u>Diplodon gregori</u> Reeside, 1927	
<u>D. haroldi</u> Reeside, 1927	
<u>Antediplodon dockumensis</u> (Simpson, 1896)	
<u>A. graciliratus</u> (Simpson, 1896)	
<u>A. dumblei</u> (Simpson, 1896)	
Subfamily Unioninae	
<u>Unio? subplanatus</u> Simpson, 1896	
<u>U.(?) thomasi</u> Henderson, 1934	
<u>U.(?) arizonensis</u> Henderson, 1934	
<u>U.(?) cristonensis</u> Meek, 1875	
<u>U.(?) terrae-rubrae</u> Meek, 1875	
<u>U.(?) gallinensis</u> Meek, 1875	
<u>U.(?) sps. 1-6</u> Kues, 1985	
Class Gastropoda	
Subclass Prosobranchia	
Order Mesogastropoda	
Superfamily Cerithiacea	
Family Pleuroceriidae	
<u>Triasmanicola assiminoides</u> Yen, 1951	
(= <u>Lioplacodes</u> by Taylor, 1975)	
<u>Lioplacodes canaliculatus</u> Yen, 1951	
<u>Triasamnola latispira</u> Yen and Reeside, 1946	
(= <u>Lioplacodes</u> by Taylor, 1975)	
<u>Triasamnicola pilsbryi</u> Yen and Reeside, 1946	
(= <u>Lioplacodes</u> by Taylor, 1975)	
Family Pilidae	
<u>Valvata gregoryi</u> (Robinson), 1915	
(= <u>Ampularia</u> by Cossmann, 1921)	

new species from single localities or localized areas. No attempt has been made to synthesize these occurrences into a coherent systematic or stratigraphic framework. The general lack of regional stratigraphic synthesis is primarily a function of the difficulty of correlation between the isolated outcrops in the Western Interior. Biostratigraphic zones are preliminary (Parrish and Long, 1983; Long and Ballew, 1985; Ash et al., 1986) and lithostratigraphic correlations are often suspect. Sedimentologic analyses and identification of lateral lithofacies relationships may improve lithostratigraphic correlations in the future (Dubiel, 1987). Problems with nonmarine mollusc classification shall be considered at two levels: the genus-species level and the supra-genus level.

The Genus-Species Level

Conchological features are used as genus and species characters in the systematics of extant unionids and prosobranch gastropods and therefore, provide useful taxonomic characters for

systematics of fossil representatives of these groups. However, significant ecophenotypic variation has been documented in extant unionids (Ortmann, 1920; Grier, 1920; Ball, 1922; Baker, 1928; Eager, 1948; Modell, 1949; Tevesz and Carter, 1981). Assessing fossil species- and genus- level variation requires examination of large, well-preserved collections and statistical analyses to discriminate valid taxonomic units from variation within a single taxonomic unit. Prosobranch gastropod shells exhibit less variation than unionid bivalves or pulmonate gastropods. But similar analyses should be conducted to discriminate valid taxonomic assignments.

The Supra-Genus Level

Unionid malacologists have long debated the utility of conchology to discriminate valid taxonomic relationships above the genus level. The debate began with the anatomical studies of Sterki (1903), Hannibal (1912), Simpson (1914) and Heard and Guckert (1981). This view is not universally endorsed, as illustrated by classifications that utilize either a synthesis of soft and hard parts (Ortmann, 1916; Davis and Fuller, 1981) or solely hard parts (Frierson, 1927; Modell, 1964; Haas, 1969; Kat, 1983a). Two shell characters are considered to provide valid supra-generic information: umbo ornamentation and conchiolin morphology. Prosobranch gastropod shells are useful in determining supra-generic relationships. Useful characters include shell form, direction of coiling, aperture shape and structures and shell ornamentation.

LATE TRIASSIC MOLLUSC SYSTEMATICS

Current status of Late Triassic nonmarine mollusc systematics. Eleven species and three genera of unionid bivalves have been described from the Upper Triassic of the Western Interior (see Table 1). Kues (1985) has recognized an additional six morphological groups, designated as Unio species 1-6 from the Bull Canyon area of New Mexico. An additional eleven species and six genera, representing two orders and four families, have been described from the Upper Triassic Newark Supergroup from the eastern United States (Table 2). Note that these species descriptions were made from 1875 through the early 1950's. Most species were described from small, isolated collections without regard to ecophenotypic variation.

Radial umbo ornamentation has been cited as a criterion for placing many of the Late Triassic unionids within the Subfamily Hyriinae of the Family Unionidae (Pilsbry, 1921; and Reeside, 1927). This was the basis for Pilsbry (1921) placing three species of Unio described by Simpson (1896) into the genus Diplodon. Marshall (1929) subsequently changed these to the genus Antediplodon because of the new unionid classification.

TABLE 2. Late Triassic freshwater mollusc taxa from the eastern U.S.

-
- Class Bivalvia
 - Subclass Lamellibranchia
 - Order Schizodonta
 - Superfamily Unionacea
 - Family uncertain
 - Subfamily uncertain
 - Bisulcus undulatus Hitchcock, 1865
 - Trisulcus laqueatus Hitchcock, 1865
 - Family Unionidae
 - Subfamily Unioninae
 - Unio(?) emersoni Troxell, 1914
 - U.(?) wilbrahamensis Emerson, 1900
 - Subfamily Hyriinae
 - Diplodon borealis Pilsbry, 1921
 - D. carolus-simpson Pilsbry, 1921
 - D. pennsylvanicus Pilsbry, 1921
 - D. yorkensis Pilsbry, 1921
 - Family Mutelidae
 - Mycetopoda dilicula Pilsbry, 1921
 - Order Pteroida
 - Superfamily Ambonychiaacea
 - Family Myalinidae
 - Naiadites triassicus Pilsbry, 1921
 - N. wanner Pilsbry, 1921

Conchiolin layer studies have been suggested by Kat (1983a) to provide significant taxonomic criteria for unionid systematics. These layers contain distinct layers and structures that are unique to various unionid supra-generic groups. Kat found conchiolin layer morphology preserved in fossil unionid bivalves as old as the Eocene Willwood Formation of Wyoming. Preliminary examination of Triassic unionids has not yet yielded sufficiently well-preserved layers to apply this tool.

Five species of gastropods representing two genera and two families have been described from the Late Triassic of the Western Interior (see Table 1). No gastropods have been reported from the Newark Supergroup to date. Three high spired species of the genus Triasamnicola (T. assiminooides Yen, 1951; T. latispira Yen and Reeside, 1946; and T. pilsbryi Yen and Reeside, 1946) have been described from the Western Interior Upper Triassic strata. Taylor (1975) considered Triasamnicola synonymous with Lioplacodes and suggested changing the genus assignment accordingly. Because Taylor's work is unpublished, I shall retain the original nomenclature. Robinson (1915) described the low spired Valvata gregoryii. These large specimens are very unlike modern valvatids, which are generally smaller than a few mm. This problem was recognized by Cossmann (1917) who considered this species to belong to Ampullaria? (= Pila, Roeding). Yen (1951) did not consider the type lot sufficiently well preserved to afford an adequate basis for generic assignment, and I shall retain the original nomenclature here also.

An indeterminate species of Viviparus has been reported from the Chinle Formation in the vicinity of Moses Rock, San Juan

County, Utah (Woodruff, 1912) and from the base of the Dolores Formation near Telluride, Colorado (Cross, 1899a). The lack of illustrations or repository information precludes evaluation of these reports. Robinson (1915) also reported the pulmonate Lymnaea hopii from the "Painted Desert beds" of northeastern Arizona. Harshbarger et al. (1957) consider this taxon to be from the Kayenta Formation and therefore, its outside of the scope of this report.

DISTRIBUTION OF LATE TRIASSIC NONMARINE MOLLUSCS IN THE WESTERN INTERIOR

Comprehensive literature search has located 82 mollusc localities in the Chinle, Dolores and Dockum Formations of Colorado, Utah, Arizona, and New Mexico. Work is still in progress on compiling Dockum Formation localities in Texas. Considerable variation in the quality of locality and taxonomic information occurs in the literature. Localities that could be identified to within township and range coordinates are plotted on Figure 1. Molluscs have been reported from essentially every large outcrop belt of Upper Triassic continental strata in the southern Western Interior. Locality information is presented in Table 3.

Unionid bivalves have been reported from several members of the Chinle Formation, and are especially abundant in the Petrified Forest Member. The large concentrations of localities occur in areas of extensive badland exposures of the Chinle areas that have yielded abundant vertebrate fossils and, therefore, have been heavily prospected. I appeal to vertebrate paleontologists and sedimentologists to collect and report mollusc localities they encounter.

Gastropods have been reported from the Chinle, Dockum and Dolores formations and are widely distributed, especially the Triasamnicola spp. Triasamnicola spp. have been recovered from the Monitor Butte, Petrified Forest and Owl Rock members of the Chinle Formation. Valvata gregoryii has only been reported from the upper Petrified Forest Member. See Table 3 for specific locality information.

TAPHONOMY OF MOLLUSC LOCALITIES

Three types of mollusc assemblages have been observed in the Chinle Formation: crevasse splay, channel fill and pond assemblages. Criteria used to describe these assemblages include: the taphonomic overprint (orientation, articulation, fragmentation, abrasion, density and size sorting), ecologic homogeneity or heterogeneity of the assemblage and sedimentology (matrix composition and texture, sedimentary structures and local lithofacies relations).

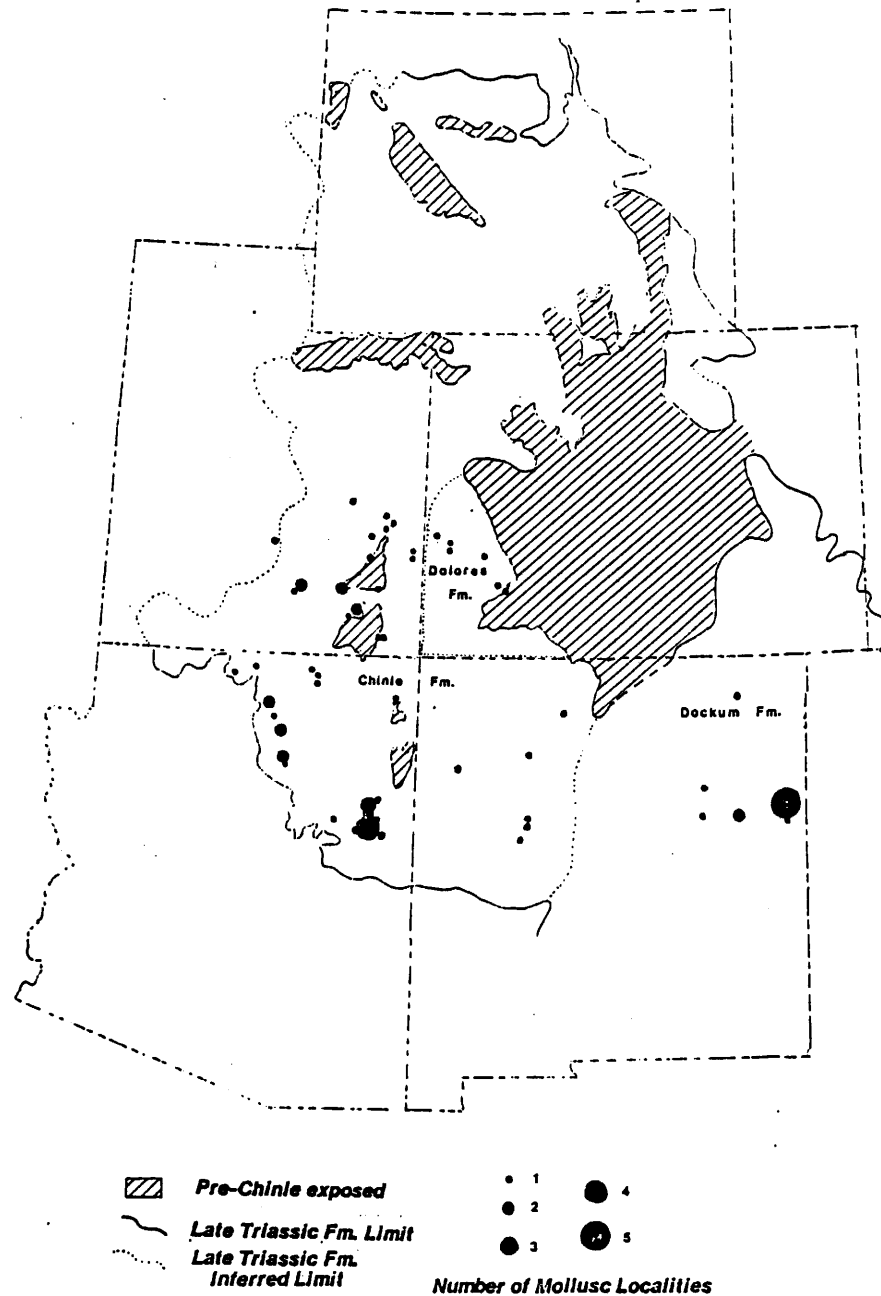


FIGURE 1. Distribution of mollusc localities in the Upper Triassic strata of the Western Interior reported in the literature.

Crevasse Splay Assemblages

Most highly concentrated unionid assemblages represent crevasse splay accumulations. These assemblages are composed of moderate to well-sorted, disarticulated, abraded unionid bivalves in current-stable orientations and local imbrication of shells in high density accumulations. These represent maximum floodstages with sufficient energy to transport the channel-bed death accumulations of unionid bivalves. These disarticulated valves