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PRELIMINARY REPORT ON CONCHOSTRACA FROM THE UPPER JURASSIC MORRISON FORMATION, WESTERN UNITED STATES

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Conchostracan fossils are common at many localities in the Brushy Basin Member of the Upper Jurassic Morrison Formation in the western United States. A preliminary study based on limited collections from Utah and Colorado indicates the presence of four taxa: *Lioestheria* sp. A, *Lioestheria* sp. B, *Euestheria tendagaruensis* (Janensch) and *Nestoria krasinetzi* (Novojilov). These conchostracans most likely indicate ephemeral lacustrine environments of fluctuating alkalinity during Brushy Basin deposition, and thus support sedimentological analyses of this unit. The Morrison conchostracan fauna clearly is of Late Jurassic age. The possibility that an older *Nestoria*-dominated assemblage (Oxfordian–Kimmeridgian) succeeded by a younger *Lioestheria*-dominated assemblage (Tithonian?) in the Brushy Basin Member needs further data to be confirmed.

Keywords: Conchostracans; Ephemeral lacustrine; Oxfordian–Kimmeridgian; Tithonian

INTRODUCTION

Conchostracans are small phyllopod crustaceans commonly referred to as "clam shrimp" because of their chitinous, bivalved carapace. Their fossil record extends from the Devonian to the Holocene in strata mostly deposited in freshwater, lacustrine environments. Jurassic conchostracans have a global distribution and have been used extensively in paleobiogeographic analysis and biostratigraphic correlations (e.g., Chen, 1985; Tasch, 1987; Chen and Hudson, 1991). Many workers have noted the local abundance

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of conchostracans in claystones of the Brushy Basin Member of the Morrison Formation of the western United States, but no published documentation or analysis of these fossils have been undertaken. Here, we present a preliminary report on some Morrison Formation conchostracans from Colorado and Utah (Fig. 1) and discuss briefly their paleoecological and biostratigraphic

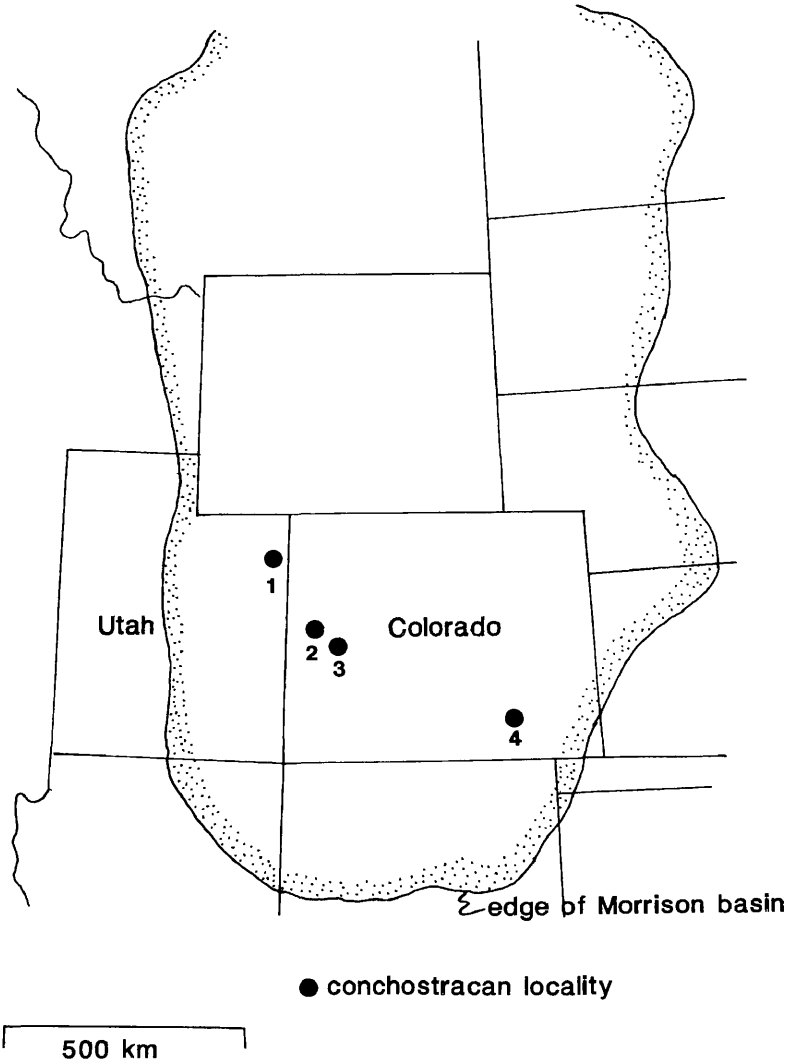

FIGURE 1 Fossil conchostracan localities in the Brushy Basin Member of the Morrison Formation. 1 – Dinosaur National Monument quarry, Utah; 2 – Wolney site, Colorado; 3 – Cactus Park, Colorado; 4 – Purgatoire River, Colorado.

significance. In this paper, measurements of conchostracans follow the protocol of Tasch (1987, fig. 18), and the following institutional acronyms are used: CU = University of Colorado at Denver, MWC = Museum of Western Colorado, Grand Junction and NMMNH = New Mexico Museum of Natural History and Science, Albuquerque.

LOCALITIES

This study is based on conchostracans from four localities, hereafter referred to as 1, 2, 3 and 4 (Fig. 1):

1. Dinosaur National Monument quarry, Utah – This site is just northwest of the Dinosaur National Monument quarry building in green smectitic mudstone of the Brushy Basin Member of the Morrison Formation in the SW1/4 NE1/4 SW1/4 sec. 26, T4S, R23E, Uintah County, Utah. This site is 188 ft above the base of the Brushy Basin Member. Fred Peterson collected the conchostracans from this site, and they are in the NMMNH collection.
2. Wolney site, Colorado – This site is in a gray, smectitic mudstone of the lower to middle part of the Brushy Basin Member of the Morrison Formation in the SE1/4 SW1/4 SW1/4 sec. 13, T13N, R3W, Mesa County, Colorado. David Wolney first collected the conchostracans from this site, and they are in the MWC collection.
3. Cactus Park, Colorado – This site is in green smectitic mudstone of the lower part of the Brushy Basin Member of the Morrison Formation in the SE1/4 NW1/4 NW1/4 sec. 9, T14S, R99W, Mesa County, Colorado. Adrian Hunt collected the conchostracans from this site, and they are in the CU collection.
4. Purgatoire River, Colorado – This site is in yellowish-gray calcareous claystone of the lower part of the Brushy Basin Member in sec. 4, T30S, R56W, Las Animas County, Colorado. Nancy Prince collected the conchostracans from this site, and they are in the CU collection.

TAXONOMY

Conchostracan taxonomy is in chaos. A comparison of the extensive works of Raymond (1946), Novozhilov (1958), Tasch (1969, 1987), and Chen (1985) reveals no consistency in the use of genus-level names. Species-level taxonomy is extremely oversplit, with little or no effort being made to

demonstrate variation within sample populations and few published comparisons of putative distinct species within a single genus. Tasch's taxonomy is more conservative than that of most non-American workers and is followed here, although some of his genera are extremely polymorphic (for example *Lioestheria*), and this lends some legitimacy to the splitting of these genera, as have both Novozhilov and Chen, among others.

Given this taxonomic situation, and the fact that our Morrison conchostracan sample sizes are small and many specimens are incomplete or poorly preserved, we believe a conservative taxonomic approach is justified. Therefore, we only tentatively attempt species-level identifications. We recognize two unidentified species-level taxa in our Morrison conchostracan collections and assign them to *Lioestheria*, and tentatively identify two other species. We also suggest some synonymies of genus-level taxa of Chen (1985).

Lioestheria sp. A

Many of the Morrison conchostracans belong to the polymorphic genus (subgenus) *Lioestheria* sensu Tasch (1987). These conchostracans have an ovate carapace, numerous finely-spaced growth lines including lines on the umbo, intervales with granulate sculpture, and lack nodes or spines. *Eosestheria* of Chen (1985) includes many forms that may belong here. *Lioestheria* sp. A here refers to forms that lack hatchures on the intervales (Fig. 2(B)–(D)). These are the most abundant kind of Morrison conchostracans and occur at all four localities. Average measurements (in mm) of 41 valves are: $H = 1.6$, $L = 2.6$, growth lines = 12, $H/L = 0.61$.

Lioestheria sp. B

Lioestheria sp. B has longitudinal striae (hatchures) on the intervales (Fig. 2(A)) but otherwise generally resembles *Lioestheria* sp. A. This form is known from localities 1, 2 and 3. Average measurements (in mm) of 25 valves are: $H = 1.1$, $L = 1.7$, growth lines = 13, $H/L = 0.65$.

Lioestheria tendagurensis (Janensch)

Locality 2 produces specimens of an elongate oval conchostracan with a terminal umbo, numerous fine growth lines and a hatchured fine sculpting on the intervales (Fig. 2(E)). This morphology closely corresponds to *Lioestheria tendagurensis* (Janensch) as redefined by Tasch (1987, pp. 55–56; also see

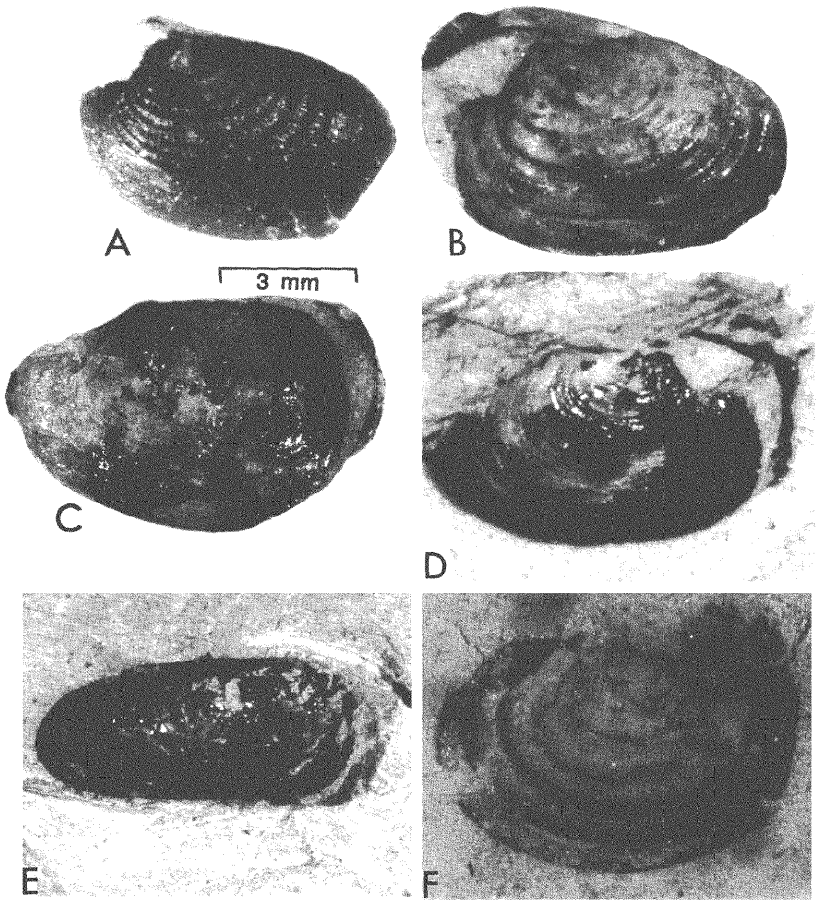

FIGURE 2 Selected conchostracans from the Brushy Basin Member of the Morrison Formation. (A) *Lioestheria* sp. B, left valve, MWC 1852. (B) *Lioestheria* sp. A, left valve, MWC 1853. (C) *Lioestheria* sp. A, left valve, MWC 1854. (D) *Lioestheria* sp. A, right valve, MWC 1858. (E) *Lioestheria tendagurensis*, right valve, MWC 1864. (F) *Nestoria krasinetzi*, right valve, CU 209.

Janensch, 1933, fig. 1). Average measurements (in mm) of six valves are: $H = 1.8$, $L = 3.8$, growth lines = 8, $H/L = 0.47$.

Nestoria krasinetzi (Novojilov)

Chen (1985, pp. 108–109, fig. 67) applies the name *Nestoria krasinetzi* (Novojilov, 1958) to conchostracans with ovoid carapaces, having a few,

widely spaced but prominent growth lines, a minute reticulate ornamentation on the intervales, a prominent smooth beak near the dorsal margin and a relatively flat anterior margin. This taxon falls within the range of variation of Tasch's polymorphic concept of *Euestheria*. Morrison Formation specimens of *Nestoria* (Fig. 2(F)) occur at localities 2 and 4 in our samples. Average measurements (in mm) of 5 valves are: $H = 1.7$, $L = 3.1$, growth lines = 6 and $H/L = 0.55$.

PALEOECOLOGY

Today, conchostracans occupy a variety of lacustrine environments including large playa lakes and marshes and less frequently the littoral areas of lakes and small permanent ponds (Webb, 1979). Within this spectrum, conchostracans prefer small (less than a hectare in area), ephemeral bodies of water. They tolerate temperatures of 4–30°C, and prosper in waters with a pH range from neutral (7) to alkaline (9.7). Because conchostracans often live in ephemeral waters, they are adapted to fluctuating salinity and alkalinity (Tasch, 1969; 1987; Webb, 1979).

Some extinct conchostracans may have inhabited shallow marine environments, but most apparently occupied habitats similar to those still inhabited by conchostracans (Webb, 1979). The local abundance of conchostracans in strata of the Brushy Basin Member thus indicates the presence of lacustrine environments, probably of small, shallow and short-lived ponds as would be associated with playa lakes. Sedimentological analyses (e.g., Bell, 1986; Prince, 1988) indicate that some Brushy Basin Member deposition took place in playa lakes, and the conchostracans certainly are consistent with these analyses. At some Brushy Basin localities (e.g., locality 2), the conchostracans occur in clearly delineated small pond deposits where carbonaceous layers are immediately overlain by conchostracan-rich strata (Kirkland and Armstrong, 1992).

BIOSTRATIGRAPHY

Given the confused taxonomy of conchostracans, their biostratigraphy is suspect. Nevertheless, we are struck by the overall similarity of the Morrison conchostracan fauna to the Late Jurassic conchostracan faunas of China identified by Chen (1982, 1985; Chen *et al.*, 1982a,b) and the conchostracans from the Tendaguru beds of Tanzania (Janensch, 1933; Tasch, 1987).

This lends support to the long held idea that the entire Brushy Basin Member of the Morrison Formation is of Late Jurassic age.

Chen (1985, 1994; also see Chen *et al.*, 1982a,b) identified two conchostracan assemblages of Late Jurassic age in China: (1) *Nestoria–Keratestheria* assemblage of Oxfordian–Kimmeridgian age; and (2) *Eosestheria* assemblage of Tithonian age. Our Morrison Formation conchostracans may consist of correlatives of both of these assemblages. The locality 4 assemblage is dominated by *Nestoria* and could be correlative with the older of Chen's assemblages, whereas the other Morrison localities are *Lioestheria*-dominated. Many of the forms Chen identifies as *Eosestheria* are probably the same as forms we identify as *Lioestheria*. Brushy Basin conchostracan localities on the Colorado Plateau (1–3) thus may be younger than the Brushy Basin Member site (4) on the High Plains. The possibility of a two-part biostratigraphic zonation of the Morrison Formation is suggested by our conchostracan collections, but they are not large enough or stratigraphically dense enough to confirm this. Further collecting and study of Morrison conchostracans are needed to develop a more refined, conchostracan-based correlation of Morrison strata.

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References

Bell, T.E. (1986) Deposition and diagenesis of the Brushy Basin Member and upper part of the Westwater Canyon Member of the Morrison Formation, San Juan Basin, New Mexico. *Amer. Assoc. Petr. Geol. Stud. Geol.*, **22**, 77–91.

Chen, P. (1982) Jurassic conchostracans from Mengyin district, Shandong. *Acta Palaeont. Sinica*, **21**, 133–139 [Chinese, English abstract].

Chen, P. (1985) *Conchostracan Systematics.* Nanjing. Beijing: Science Press, 241 pp. [in Chinese].

Chen, P. (1994) Cretaceous conchostracan faunas of China. *Cret. Res.*, **15**, 259–269.

Chen, P. and J.D. Hudson (1991) The conchostracan fauna of the Great Estuarine Group, Middle Jurassic, Scotland. *Palaeont.*, **34**, 515–545.

Chen, P., W. Li, J. Chen, C. Ye, Z. Wang, Y. Shen, and D. Sun (1982a) Sequence of fossil biotic groups of Jurassic and Cretaceous in China. *Sci. Sinica B*, **25**, 1011–1020.

Chen, P., W. Li, J. Chen, C. Ye, Z. Wang, Y. Shen, and D. Sun (1982b) Stratigraphical classification of Jurassic and Cretaceous in China. *Sci. Sinica B*, **25**, 1227–1248.

Janensch, W. (1933) Eine *Estheria* aus den Tendaguruschichten. *Palaeontogr. supl.*, **7**, 97–98.

Kirkland, J.I. and H.J. Armstrong (1992) Taphonomy of the Mygatt-Moore quarry, middle Brushy Basin Member, Morrison Formation (Upper Jurassic), western Colorado. *J. Vert. Paleont.*, **12**, 3 supl., 40A.

Novojilov, N.I. (1958) Novy vidiy Conchostraca iz Zhivetskovo Yarusa Tuviy. *Mat. Osn. Paleont.*, **2**, 41–45 [in Russian].

Prince, N.K. (1988) *Lacustrine deposition in the Jurassic Morrison Formation, Purgatoire River region, southeastern Colorado* [M.S. thesis]. Denver: Univ. Colorado, 181 pp.

Raymond, E. (1946) The genera of fossil conchostracans – an order of bivalved Crustacea. *Bull. Mus. Comp. Zool.*, **96**, 218–307.

Tasch (1969) Branchiopoda. *Treatise on Invertebrate Paleontology,* R. Lawrence, Kansas: Univ. Kansas Press, pp. R128–R191.

Tasch (1987) Fossil Conchostraca of the southern hemisphere and continental drift. *Geol. Soc. Amer. Mem.*, **165**, 290 pp.

Webb, J.A. (1979) A reappraisal of the palaeoecology of conchostracans (Crustacea: Branchiopoda). *N. Jb. Geol. Paläont. Abh.*, **158**, 259–275.