A new species of the genus *Mexipyrgus* Taylor, 1966 (Caenogastropoda: Truncatelloidea: Cochliopidae) from late Holocene spring deposits in Viesca, Coahuila, Mexico

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ABSTRACT

A new species of the genus *Mexipyrgus* Taylor, 1966 (Caenogastropoda: Truncatelloidea: Cochliopidae) is described from two Holocene springs in Viesca, Coahuila, Mexico. Previously, only one species was known in this genus, *Mexipyrgus carranzae* Taylor, from freshwater springs and streams in the Cuatrociénegas Valley in Coahuila, Mexico. Similar to the extant species, the shells of *Mexipyrgus viescaensis* new species show a high level of morphological variability.

Additional Keywords: *Mexipyrgus carranzae*, freshwater gastropod, subfossil endemic

INTRODUCTION

The Chihuahuan Desert in United States and Mexico is considered as a hotspot of molluscan diversity, with a high number of endemic gastropod species (Hershler, 2011). One of the most interesting sites in this desert is Cuatrociénegas Valley in Coahuila, Mexico. The relatively small valley contains more than 70 endemic species of animals and plants, and is biologically the most diverse site in North America, in relation to endemism (Stein et al., 2000). The malacologist Dwight Willard Taylor, who had presented a first monograph of the snails of Cuatrociénegas, considered the mollusks of this site as "...the most spectacularly endemic fauna of freshwater snails known in the Western Hemisphere..." (Taylor, 1966). The freshwater ecosystem of Cuatrociénegas includes five endemic genera of hydrobiid snails (*Paludiscala*, *Coahuilix*, *Mexithauma*, *Nymphophilus* and *Mexipyrgus*). Fossil records of Cuatrociénegas endemic species from other sites were reported only by Czaja et al. (2014a). The authors discovered in the Valley of Sobaco, Coahuila, a system of paleo-lakes with a malacofauna similar to the modern snail communities of Cuatrociénegas. This includes the endemic genus *Coahuilix*.

Mexipyrgus is a Mexican endemic freshwater hydrobiid gastropod that lives in springs, lakes, and the Mezquites River in the Valley of Cuatrociénegas. Its main morphological characteristic is a thickened, strongly sculptured shell with color banding. All these shell features are unusual for freshwater snails, especially within the family Cochliopidae. Geographic variation in shell morphometry of *Mexipyrgus* was analyzed by Hershler and Hayek (1988). Aspects of ecology and coevolution between *Mexipyrgus carranzae* and its fish predator, *Herichthys minckleyi*, have been subject of various investigations (Smith, 1982; Tang and Roopnarine, 2003; Johnson et al., 2007; Covich 2010; Chaves-Campos et al., 2012).

In sediments of two recently dried-up springs near the town Viesca, Coahuila, specimens of a second species of the genus *Mexipyrgus* Taylor were collected (Figure 1). The springs are located at the foot of the *Sierra la Cadena* and belong to a system of several water bodies that have provided water to small settlements at the vicinity. Both sites contain an abundance of shells including several possibly new species of *Tryonia*, *Pyrgulopsis* and *Pyrgophorus* (Czaja, personal data). Similar to *Mexipyrgus carranzae* from Cuatrociénegas, the shells from Viesca possess a high level of phenotypic variability. The aim of the present study is to describe the new species of *Mexipyrgus* and to show its similarities and differences to the living species from Cuatrociénegas.

MATERIALS AND METHODS

Specimens of *Mexipyrgus viescaensis* new species were collected from two recently dried-up springs near the town Viesca, Coahuila, Mexico, approximately 2 km south of the locality Venustiano Carranza (spring El Molino: 25°19′55″ N, 102°55′49″W; spring Hacienda de Hornos y Carranza: 25°20′05″ N, 102°57′39″ W). The material derives from outcrops on the edges of the springs. The

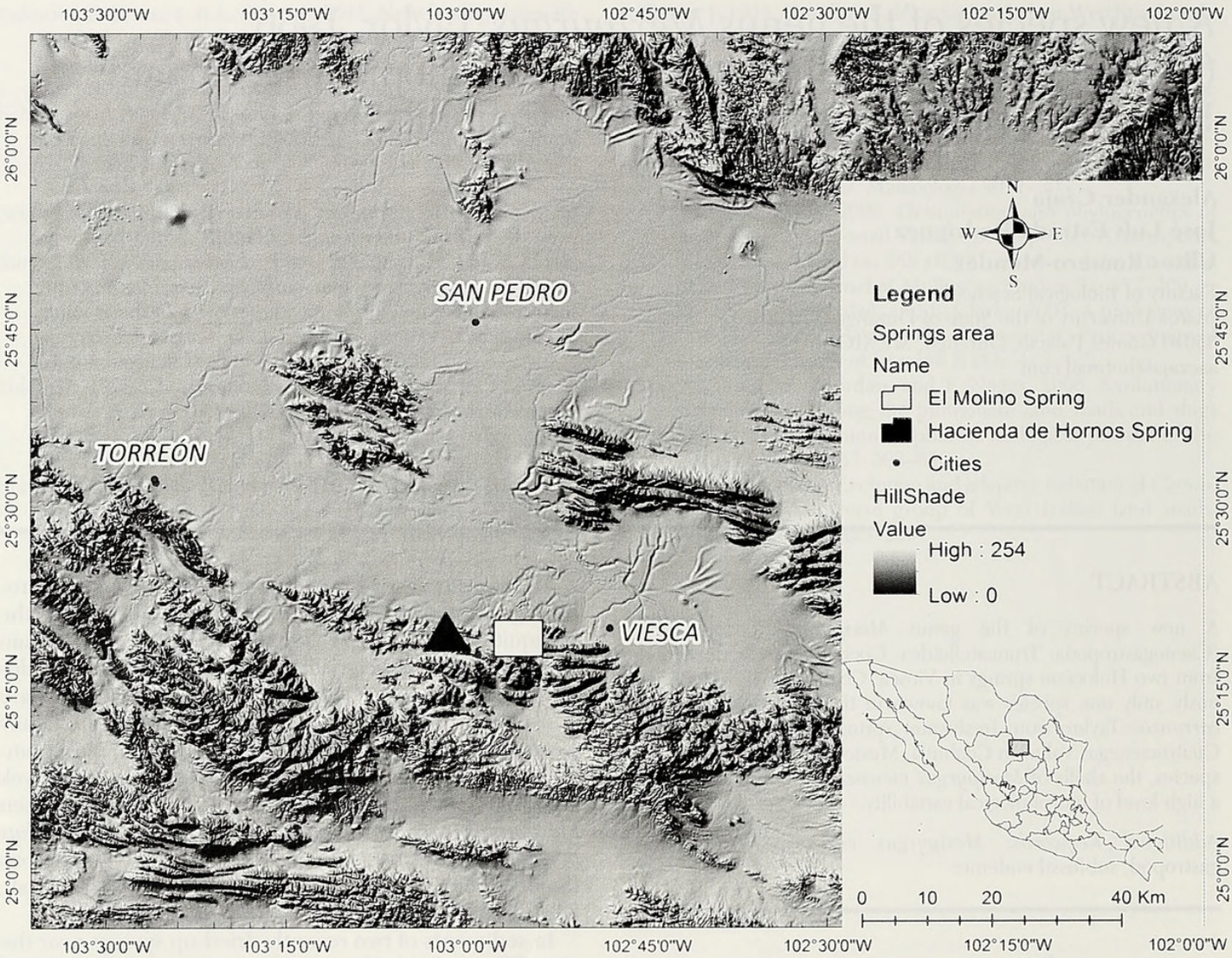


Figure 1. Map of the study area with localization of the springs of Viesca.

section is approximately 1.5 m thick and contains unconsolidated sediments, small travertine pieces and shell debris. The sub-recent (late Holocene) age of the superficial deposits is confirmed by several reports and photographs which document the desiccation of the springs during the drought of 1958/59.

The sediments of both sites were screened through 0.5 mm and 0.3 mm sieves. The shells were photographed with a Zeiss AxioCam ERc5s microscope-camera. The shells of the new species were compared directly with *Mexipyrgus carranzae* from the Malacological Collection of the Faculty of Biological Sciences, Juarez State University of Durango. All collected material is housed at the same Faculty.

SYSTEMATICS

Class Gastropoda Cuvier, 1795
Subclass Caenogastropoda Cox, 1960
Superfamily Truncatelloidea Gray, 1840
Family Cochliopidae Tryon, 1866

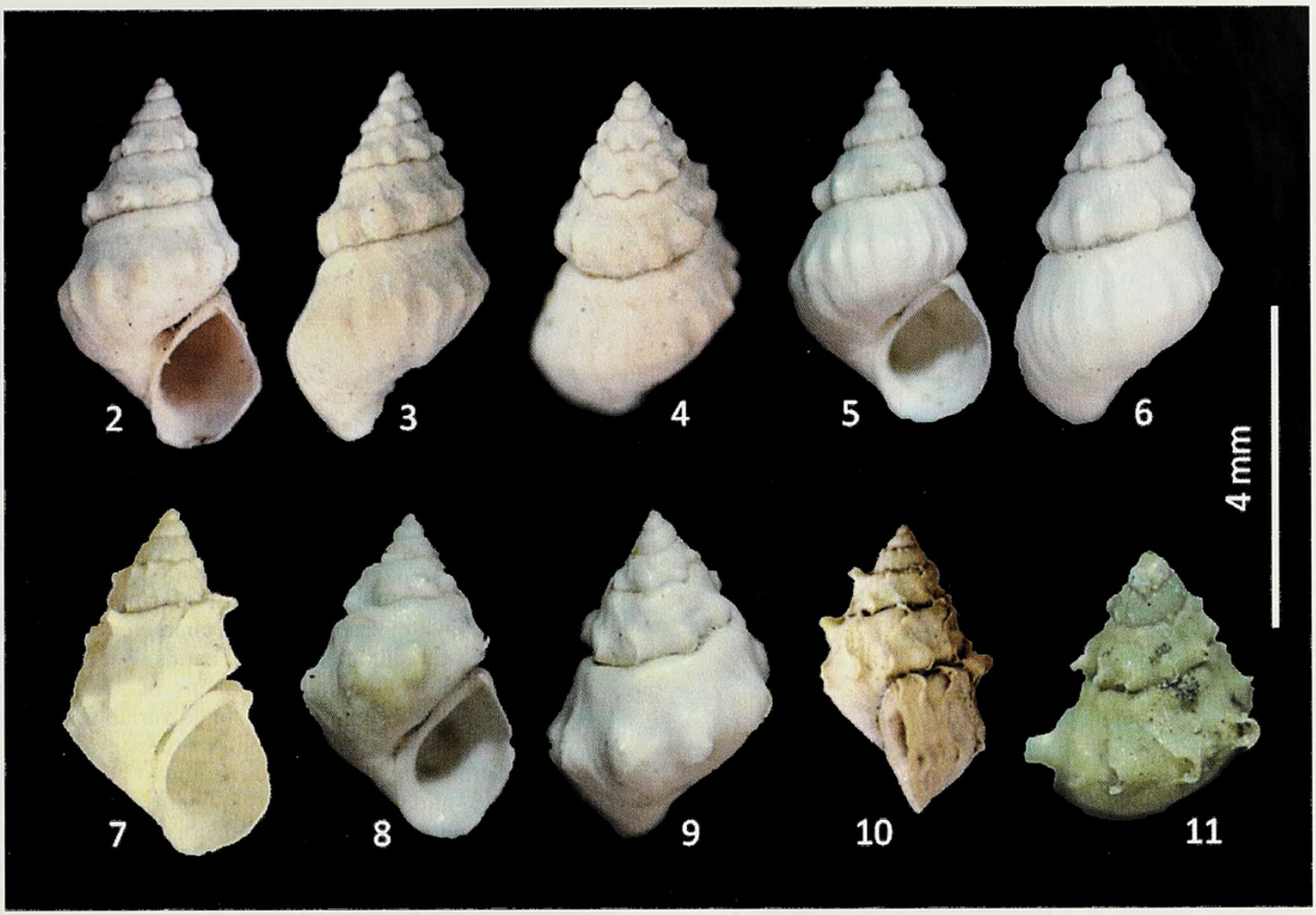
Genus *Mexipyrgus* Taylor, 1966

Type Species: *Mexipyrgus carranzae* Taylor, 1966 (by original designation).

Mexipyrgus viescaensis new species (Figures 2–11)

Diagnosis: Shell medium-sized, thick, white to beige colored, conical to turriform, height 3.18–4.90mm, width 1.99–2.45mm (shell measurements in Table 1), with 5.25 to 6.25 whorls, whorls flattened, aperture elongate-ovate, outer lip prosocyrt, inner lip not adnate to parietal wall, sculpture with strong spiral and axial elements, with prominent knobbed ribs or spines, sculpture variable.

Description: Shell medium-sized, thickened, conical to turriform, with 5.00–6.25 whorls. Whorls flattened with sutures not very impressed; lower whorls develop a prominent spiral swelling anterior to suture (subsutural cord). Height 3.18–4.90 mm, width 1.99–2.45 mm. Aperture elongate-ovate, somewhat pyriform, angulate



Figures 2–11. *Mexipyrgus viescaensis* new species. **2–4.** Holotype, UJMC-200. **5–6.** Paratype 1, UJMC-201. **7.** Specimen showing spines, UJMC-202. **8–9.** Paratype 2, UJMC-203. **10–11.** Specimens with shovel-shaped spines. **10.** UJMC-204. **11.** UJMC-205.

above; inner lip not adnate to parietal wall forming a narrow gap between lip and pariental wall; outer lip strongly prosocyrt; aperture 1.90 mm height and 1.25 mm wide (holotype). Protoconch and second whorl smooth. Sculpture with spiral and axial elements beginning at third whorl; spiral cords close to suture; wave-like axial ribs developing on third whorl, with prominent knobs where they cross spiral cords; knobs at lower part of whorls prominent, sometimes with shovel-shaped spines emerging from sub-sutural knobs; after third whorl knobbed ribs very prominent; sculpture reduced on last part of body whorl. Axial growth lines prosocyrt to sinusoidal, prominent. Color beige or white, original coloring (periostracal color bands?) and operculum not preserved.

Type Material: Holotype (Figures 1–3, 15), UJMC-200, 4.15 mm height, 2.05 mm width, 6.25 whorls. Paratype 1 (Figures 5, 6), UJMC-201, 4.22 mm height, 2.39 mm width, 6.00 whorls. Paratype 2 (Figures 8, 9), UJMC-203, 4.09 mm height, 2.50 mm width, 5.25 whorls. Alexander Czaja and José Luis Estrada-Rodríguez coll., 2014. All from type locality.

Type Locality: Spring *Hacienda de Hornos y Carranza*, ca. 15 km west of the town Viesca, Coahuila, Mexico (25°20′05″ N, 102°57′39″ W).

Stratum Typicum: Holocene (sub-recent).

Other Material Examined: More than 500 specimens from the type locality and 215 specimens from spring El Molino.

Etymology: The new species is named after Viesca, Coahuila, a small town near the dried springs.

Geographic Distribution: Endemic to the springs *Hacienda de Hornos y Carranza* and *El Molino* near Viesca, Coahuila, Mexico.

Remarks: The new species differs from other members of the family Cochliopidae by their strongly thickened and highly sculptured shells with spiral cords and knobbed ribs, which allocate the species into the genus *Mexipyrgus*. Some species of the genera *Tryonia*, *Pyrgophorus*, and *Lithococcus* also have sculptured shells but differ by the following characters: species of the first

Table 1. Measurements and basic statistics of length and width of shells of *Mexipyrgus viescaensis* new species. $\bar{x}$ = mean, σ_x = standard deviation, N = sample size.

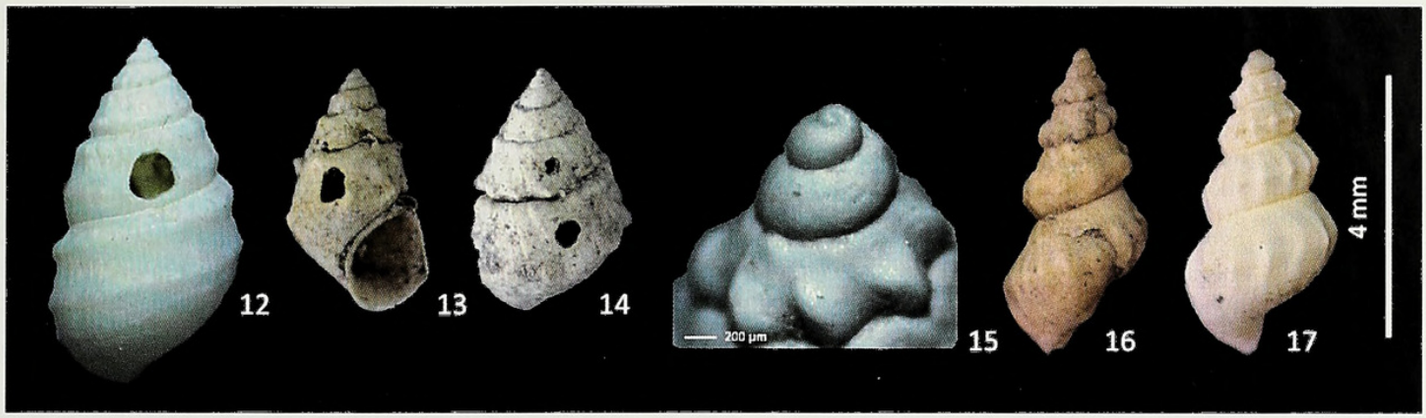
Specimen	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	$\bar{x}$	σ_x	N
Length (in mm)	3.51	4.09	3.62	3.42	3.71	3.63	4.01	3.81	3.43	4.12	4	3.91	3.72	3.18	3.82	3.41	3.42	3.92	4.22	3.67	3.73	3.72	20
Width (in mm)	2.01	2.5	2.38	2.01	2.42	2.11	2.45	2.13	1.99	2.21	2.51	2.22	2.19	2.03	2.24	2.39	2.01	2.12	2.39	2.29	2.23	0.177	20
No. whorls	5.25	5.25	5.25	5.25	5.25	5.25	5.50	5.50	5.25	6.00	5.00	6.00	5.25	5.00	5.25	5.25	5.25	5.25	6.25	6.00	5.41	0.356	20

two genera do not have knobbed ribs and the shells of *Lithococcus* are globose-trochoid.

Considerable variation of shell features occurs among the populations of both sites where the species was found. Variation showing ribs with reduced knobs is shown on Figure 13. That morphotype possesses two spiral cords with knobbed ribs close to the sutures. The number of knobbed ribs on the whorls varies between 8 and more than 20 (Figures 5, 6, and 8) and, in particular, specimens from *Hacienda de Hornos y Carranza* Spring have shells with numerous fine ribs (Figures 5 and 6). Figures 7, 10, and 11 show another variation with prolonged spines on the spiral cords. In some specimens from the *El Molino* Spring these shovel-shaped spines on the knobs are sometimes connected between the sutures (Figure 10). This phenotype is the least similar to the holotype and shells with this kind of sculpture are smaller, reaching just 3.5 cm in length. Intergradation occurs among the morphotypes from the same springs but most shells closely resemble the holotype.

Originally six nominal species of *Mexipyrgus* were described by Taylor (1966), based on characters like shell size, shell sculpture and periostracal bands. But Hershler (1985) could prove that all specimens of *Mexipyrgus* from Cuatrociénegas belong to a single variable species and that the differences in the shell features are dependent on environmental factors. According to Vermeij and Covich (1978) and Covich (2010) *Mexipyrgus* and other snails from Cuatrociénegas evolved in coevolution with snail-eating cichlid fishes. Also the sub-recent material of both springs of Viesca show a high level of phenotypic variability among the populations in time and space. We find in the same horizons with specimens of *Mexipyrgus* pharyngeal teeth of fishes (probably cichlids). Approximately 10% of all shells in the springs were perforated (Figures 13–14). Similar holes in shells were described recently by Rasser and Covich (2014) from Miocene Lake Steinheim, Germany, and interpreted as perforations of a fish predator. We suppose that the thickened and strongly sculptured shells of *Mexipyrgus* of both springs could be a direct adaptive response to strong fish predation. Further studies on shells of the new *Mexipyrgus* from Viesca will show more details of the predator-prey interaction during the coevolution of these species.

Mexipyrgus viescaensis is clearly distinguished from *Mexipyrgus carranzae* mainly by its size and by the sculpture of the shells. While shells of *M. carranzae* attain a length up to 8.45mm (Hershler, 1985, p. 99), the largest specimens from Viesca reach just 4.85mm. Shells of *Mexipyrgus carranzae* are thicker (more than 0.25mm thickness) than specimens from Viesca (less than 0.20mm thickness). Most diverse and stronger is the sculpture of shells of *M. viescaensis* with very prominent and strong knobs on the spiral cords and shovel-shaped spines. Spines on whorls have never been observed on living snails from Cuatrociénegas. Another difference is that by *M. viescaensis* the inner lip are not adnate to the parietal wall forming a narrow gap between the lip and pariental wall. Shells of *M. carranzae* lack this gap.



Figures 12–17. *Mexipyrgus viescaensis* new species, *Mexipyrgus carranzae* Taylor, from Poza Becerra, Cuatrociénegas Valley, Coahuila, Mexico, and *Tryonia hershleri* Czaja and Estrada-Rodríguez from Paleolake Irritila, Coahuila, Mexico. **12.** *Mexipyrgus carranzae* Taylor, hole on the ab-apertural side on the shell. **13.** *Mexipyrgus viescaensis* new species, hole on the apertural side on the shell. **14.** *Mexipyrgus viescaensis* new species, double holes on the ab-apertural side on the shell. **15.** *Mexipyrgus viescaensis* new species, Holotype (UJMC-200), protoconch view. **16.** *Mexipyrgus viescaensis* new species from Viesca, Coahuila. **17.** *Tryonia hershleri* Czaja and Estrada-Rodríguez from Pleistocene Paleolake Irritila, Coahuila, Mexico.

The findings of a new species of *Mexipyrgus* shed new light on the origin of the endemic *M. carranzae* from Cuatrociénegas. Of the five endemic genera from Cuatrociénegas Valley, four, *Coahuilix*, *Paludiscala*, *Nymphophilus*, and *Mexipyrgus*, have already been found as (sub-) fossils outside the basin (Hershler, 1985; Czaja et al., 2014a; Czaja, personal data). *Mexipyrgus* is possibly a relict genus which originally had a wider distribution with different species. Interestingly, some morphotypes of *M. viescaensis* show great similarity with shells of *Tryonia hershleri* (Figures 16–17). This species with thickened and strong sculptured shells was newly reported from Late Pleistocene deposits near Viesca (Czaja and Estrada-Rodríguez, 2015). This similarity may be due to convergence but on the other hand, there are also molecular evidences that both genera are closely related (Hershler et al., 1999; Hershler et al., 2005). This might be proved only by fossil findings in Cuatrociénegas Valley and Viesca. Future work on sub-fossil shells in both localities will allow us to know more on the evolutionary path of the enigmatic genus *Mexipyrgus* from northern Mexico.

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