

## A MACTRID BIVALVE FROM PLEISTOCENE DEPOSITS OF LAKE RUSSELL, MONO BASIN, CALIFORNIA

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### INTRODUCTION

**R**ANGIA DES MOULINS, 1832 is a small genus of macrid bivalves that is currently distributed in estuarine waters of the eastern United States, Gulf of Mexico, and Gulf of California (Keen, 1971; Abbott, 1974). (One congener, *R. cuneata* [Sowerby, 1831], was recently introduced to the Antwerp (Belgium) harbor [Verween et al., 2006].) Although these clams are euryhaline and capable of living in freshwater as adults, they require an estuarine-like salinity regime for successful reproduction and recruitment (Cain, 1973; Hopkins et al., 1974), which has constrained their ability to penetrate the North American continental interior through coastal drainages (Cain, 1974; Swingle and Brand, 1974). The Neogene and Quaternary fossil record of the genus is also restricted to coastal or near-coastal marine-influenced depositional systems, with the exception of Holocene specimens of *R. cuneata* from two archeological sites in the central United States which were obviously introduced by humans (Baker, 1941; Hill, 1983), and a Pleistocene(?) occurrence of this species from along the Pecos River in New Mexico (more than 800 km from the sea) which has been attributed to transport of Gulf Coast immigrants on waterfowl (Metcalf, 1980; Taylor, 1985). Here we provide fossil evidence that the biogeographic history of this predominantly brackish-coastal genus also includes avian-assisted colonization of a far inland lake in the western United States—Pleistocene Lake Russell, Mono Basin, California (Fig. 1).

The Mono Basin specimens of *Rangia* described herein were recently discovered by one of us (ASJ) in a sandy deposit closely proximal to beach cobbles, a wave-cut notch and trim line (Fig. 2). This site is in the southeastern portion of the basin near the elevation of the penultimate highstand of Lake Russell, which was constrained by the Adobe spillway into the Owens River drainage (Blackwelder, 1931; Putnam, 1949, 1950; Reheis et al., 2002). This highstand was coeval with the Tahoe (penultimate) glaciation, which probably occurred 130–150 ka (oxygen isotope stage 6) (Reheis et al., 2002; Kaufman et al., 2004; Jayko and Bacon, 2008). The shells were reworked and, although fairly abundant, mostly found as broken fragments. Abundant fragments and a few nearly intact shells were also found in a very shallow road cut; this deposit was previously mapped as older beach gravel (Reheis et al., 2002). We consider the Mono Basin occurrence of *Rangia* to be native because none of the shells were found with perforations, ground surfaces or other indications of ornamental reworking by indigenous people (e.g., Fisher et al., 1979) and because the area in which the shells were found did not contain any lithic scatter (small worked flakes of obsidian or cherty material) or ceramics typically associated with middens or human occupation sites.

A planorbid gastropod, *Vorticifex gesteri* (Hanna, 1963), was also collected from Tahoe strandline deposits about 2 km to the south-southwest of the *R. lecontei* locality. This snail and other freshwater mollusks were previously reported in other parts of the basin from deposits thought to be Pliocene in age (Hanna, 1963; Firby, 1969; Taylor, 1985). More recent field investigations and U-series dating suggest a late Pleistocene age for these deposits

consistent with the results reported herein (Reheis et al., 2002; Jayko, unpublished mapping).

Institutional abbreviations are as follows: ANSP, Academy of Natural Sciences of Philadelphia; LACMIP, Department of Invertebrate Paleontology, Los Angeles County Museum of Natural History; USNM, former United States National Museum, collections now in National Museum of Natural History, Smithsonian Institution, Washington, D.C.

### SYSTEMATIC PALEONTOLOGY

Family MACTRIDAE Lamarck, 1809

Genus RANGIA Des Moullins, 1832

RANGIA LECONTEI Conrad, 1853

Figure 3.1–8

*Gnathodon lecontei* CONRAD, 1853, pl. XXIV, figs. 1, 2.

*Rangia lecontei*, Conrad, CONRAD, 1860:232.

Additional synonymy provided by Taylor (1966:58–59).

**Diagnosis.**—Shell medium-sized (length, 16–30 mm); ovate-triangular; posterior (umbonal) slope carinate; lateral teeth long, serrated. Differs from its western North American congener, *R. mendica* (Gould, 1851), in its heavier shell and longer lateral teeth. Distinguished from closely similar eastern North American *R. cuneata* by its smaller, lighter shell; more closely adjacent beaks; and smaller pallial sinus.

**Referred material.**—USNM 1113911, three disarticulated valves from well-developed strandline of pluvial Lake Russell, Mono Basin, Mono County, California, UTM zone 11, 0345661E, 4216553N, elevation 2195 m, Alameda Wells 7.5' quadrangle, coll. ASJ 6/15/2007.

**Other material examined.**—USNM 6833, in bank of Carrizo Creek, Arizona (probable syntypes); USNM 612220, USNM 612204, 91.4 m (100 yards) toward Bombay Beach from highway (California State Route 111), Salton Basin, Imperial County, California.

**Occurrence.**—Palm Spring and Borrego Formations, Salton Basin, California (Pliocene–Pleistocene); plus new record from Lake Russell highstand deposits, Mono Basin, California (middle Pleistocene).

**Discussion.**—Mono Basin specimens are chalky white, coated with light tufa or secondary carbonate, and lack any trace of periostracum. The single almost-entire valve that was found (Fig. 3.1, 3.2) was 24 mm long; fragments of others suggest considerably larger specimens. Although the specimens are worn, they closely conform to Conrad's description and illustrations and to material collected from the type locality area (Fig. 3.3, 3.4; also see Taylor, 1966, pls. 2, 3).

Conrad (1853) described *R. lecontei* from material that J. L. LeConte collected from limestone beds north of Carisco (=Carrizo per Taylor, 1966) Creek in the southern part of the Salton Basin. He did not mention types or provide museum catalog numbers in his description, but he illustrated (bereft of measurements or a scale) three shells (Conrad, 1853, pl. XXIV, figs. 1, 2), including two apparently different right valves. Dall (1894:100) referred to USNM 6833, which consists of two valves, as the type lot of *R. lecontei* and illustrated one of the shells (Fig. 3.5, 3.6),

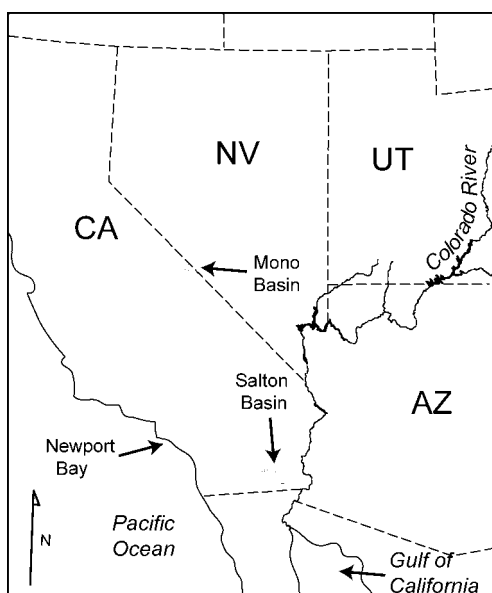


FIGURE 1—Map showing location of the Mono Basin and other *Rangia lecontei* (Conrad, 1853) sites (filled circles).

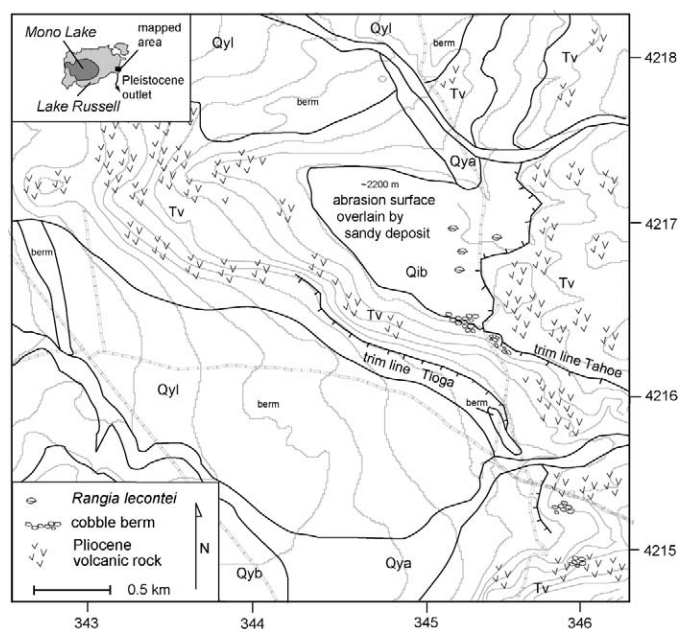


FIGURE 2—Map of the *R. lecontei* locality in Mono Basin. The insert shows the location of this site in relation to Lake Russell and its modern remnant, Mono Lake. Gridmarks are UTM coordinates.

which Schuchert (1905) subsequently identified as the holotype of this species. The original label associated with this lot reads “*Gnathodon lecontei* Conr., type, Colorado Desert, Leconte, . . . in bank of Carisco Creek” and the handwriting is similar to that of Conrad (per Moore, 1962, plates 1, 2). Taylor (1966:59) contended that the specimen figured by Dall does not agree with Conrad’s illustrations of *R. lecontei* and that the other valve from USNM 6833 (Fig. 3.7, 3.8) is probably *R. cuneata*. He also noted that data in the USNM ledger differ (in terms of specimen count and locality) from what is written on the original label and concluded that USNM 6833 is probably not from Conrad’s original material for *R. lecontei*. We are less impressed with the differences between these two valves and Conrad’s illustrations of *R. lecontei* and ascribe less significance to the discrepancy between the ledger and the original label data for USNM 6833, which could be the product of a cataloging error. In our view, the two specimens in USNM 6833 are probable syntypes of *R. lecontei*. Note that Schuchert’s (1905) listing of Dall’s figure as the holotype of *R. lecontei* cannot be accepted as an inadvertent lectotype designation because Conrad’s description was clearly based on more than one specimen (ICZN Article 74.5).

The Pleistocene fossils from the Palos Verdes Sand that Kanakoff and Emerson (1959) referred to *R. lecontei* (LACMIP 576, east bluff above Newport Bay, Newport Beach, Orange County, California) have not been described or illustrated in the literature. One of the two specimens in this lot is an articulated shell 22 mm long with traces of brown periostracum that resembles *R. lecontei* in its size, trigonal shape, carinated posterior slope, and abutting beaks (Fig. 3.9, 3.10); however further identification is problematic because the inner surface of the shell cannot be viewed. The lot also contains a smaller (19.6 mm length) pair of disarticulated valves (obviously from a single clam) which resembles *R. lecontei* in hinge structure but has a smaller beak and is relatively longer than other shells of this species that we have seen (Fig. 3.11, 3.12). This possibly mixed lot is also problematic because there are no other fossil occurrences of *Rangia* from along the Pacific Coast of North America. Given that LACMIP 576 cannot be unequivocally identified as *R. lecontei*, we suggest treating it as *Rangia* sp. indet. pending collection and study of other specimens from the Palos Verdes Sand.

#### DISCUSSION

The Pleistocene occurrence of *R. lecontei* in the Mono Basin represents only the second far-inland record within the genus and perhaps the entire Mactridae, whose long fossil record (Saul, 1973) is considered to be almost exclusively marine (Taylor, 1988). It is reasonable to assume, based on the prevailing biogeographic pattern of the genus and the spatial-temporal distribution of *R. lecontei*, that the Mono Basin population was founded by colonists from the Salton Basin. Colonization was almost certainly the product of some form of overland transport rather than aquatic dispersal, given that the southwestern Great Basin (which includes Mono Basin) has not been hydrographically connected to the Colorado River since the late Miocene or middle Pliocene and has been topographically closed since around the early Pleistocene (Brown and Rosen, 1995). The most likely venue, in our view, was transport on waterfowl, as previously postulated by Metcalf (1980) to explain the other far inland occurrence of *Rangia*. Note that Lake Russell was probably near its highstand elevation at the time of this colonization event.

Both of the prior far inland excursions of *Rangia* were transitory and unsuccessful in the biogeographic sense. Nonetheless, they are significant because they suggest a previously unappreciated capacity for long distance dispersal of these clams that is not dependent on continuous reaches of aquatic (estuarine) habitat. The discovery of *Rangia* in the Mono Basin is additionally significant because it adds to the list of marine-affiliated organisms—foraminifers (Smith, 1960; Patterson, 1987; Jayko et al., 2008), gastropods (Berry, 1947; Hershler, 1987; Hershler and Liu, 2008) and ostracodes (Forester et al., 2005; Jayko et al., 2008)—that were apparently introduced to the region during the late Neogene by waterfowl traveling along the Pacific Flyway. The fact that these marine elements appear to have been concentrated in the Death Valley region by long distance dispersal on birds strikes us as highly relevant to the ongoing debate concerning the origin of the marine-like biota of the Miocene to Pliocene Bouse Formation, which crops out along the lower Colorado River valley just to the south of this region (McDougall, 2008; Spencer et al., 2008).

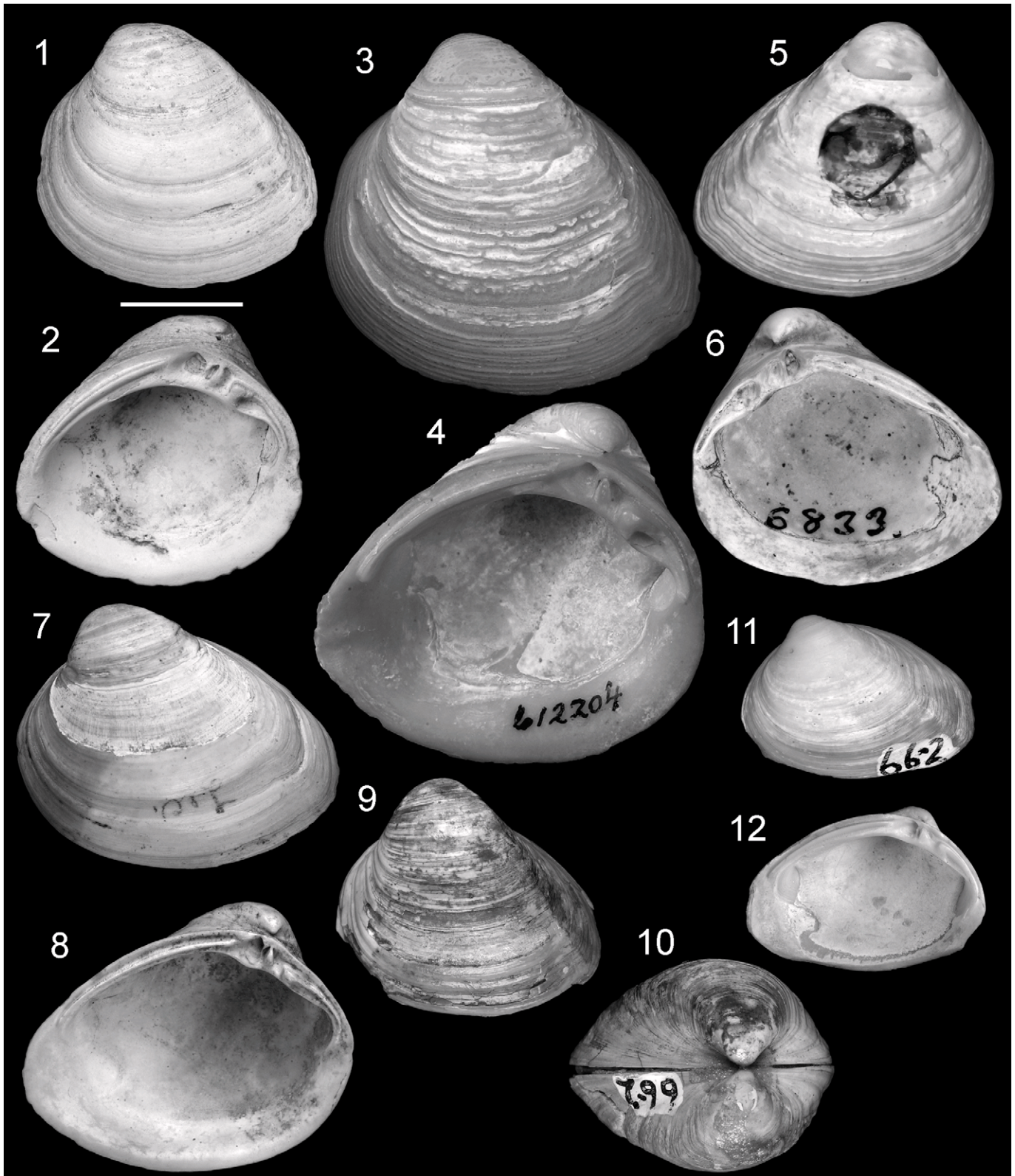


FIGURE 3—Shells of *Rangia lecontei* (1–8) and *R. sp. indet.* (9–12). 1, 2, USNM 1113911, Mono Basin, left valve; 3, 4, USNM 612204, Salton Basin, left valve; 5, 6, USNM 6833, probable syntype, Salton Basin, right valve; 7, 8, USNM 6833, probable syntype, left valve; 9, 10, LACMIP 576, Newport Bay, left, dorsal views respectively; 11, 12, LACMIP 576, left valve. Scale bar = 10 mm.

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