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NOTES ON GEOGRAPHIC DISTRIBUTION

First record of the invasive Asian Clam, *Corbicula fluminea* (O.F. Müller, 1774) (Bivalvia, Cyrenidae), in Baja California Sur, Mexico

Roberto Carmona[1,2], **David Carmona**[1], **Francisco Omar López-Fuerte**[1], **Enrique Flores**[1]

1 Departamento Académico de Ciencias Marinas y Costeras, Universidad Autónoma de Baja California Sur, La Paz, Baja California Sur, México
2 Pronatura Noroeste, Asociación Civil. Ensenada, Baja California, México

Corresponding author: Francisco Omar López Fuerte (folopez@uabcs.mx)

Abstract. The Asian Clam, *Corbicula fluminea* (O.F. Müller, 1774), is a high-risk invasive species in Mexico. The first record for the country dates back to 1969, and by 2024 its presence had been documented in 26 of the 32 Mexican states. In June 2025, the presence of *C. fluminea* was detected in the San Ignacio oasis, which has potential repercussions for endemic species there and highlights the urgent need to implement a control and eradication program for *C. fluminea* in the San Ignacio oasis. Monitoring of nearby oases is also necessary.

Key words. Baja California Peninsula, habitat alteration, invasive mollusks, oasis

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Introduction

Baja California Sur (BCS) is one of the two states on the Baja California Peninsula. This peninsula is the most arid region of Mexico, with mean annual precipitation below 200 mm over most of its territory (Coria 1997). The geomorphological evolution of the Baja California Peninsula has led to a change in vegetation from subtropical mesic to xerophytic scrub (Axelron 1948). Through this process, a series of refuges called oases have formed, which, although they represent only 0.1% of the peninsula's surface area, are of particular biological interest as they represent biogeographical and evolutionary relicts for some species (Arriaga 1997; Maya et al. 1997). Currently, 184 oases have been recognised in the Baja California Peninsula (93% in BCS). These oases are characterised by a discontinuous distribution (Maya et al. 1997). They are subject to both natural and anthropic pressures, including cyclones, drought, fires, overgrazing, and excessive hydric overexploitation (Rodríguez-Estrella et al. 1999; Córdoba-Rojas et al. 2024). These pressures compromise the ecosystemic services that these bodies of water provide.

Despite their limited extent and discontinuity, the oases of BCS concentrate a substantial proportion of the state's biodiversity and a considerable number of endemic species, such as the fish *Fundulus lima* (Vaillant, 1894) (Ruiz-Campos et al. 2006) and the songbird *Geothlypis beldingi* (Ridgway, 1882) (Marrón and Carmona 2024). Unfortunately, these oases now face a broad threat due to the presence of exotic and invasive species (Ruiz-Campos et al. 2014). Concern exists, for example, over the spread of Giant Reed, *Arundo donax* (Linnaeus, 1753) (Silva-Ávila et al. 2023), which is one of the 100 most pernicious invasive plant species worldwide (Lowe et al. 2000).

Of the exotic fauna, various invasive taxonomic groups have been reported, including crustaceans (*Procambarus clarkii* (Girard, 1852); Hernández et al. 2008), amphibians (*Lithobates catesbeianus* (Shaw, 1802); Luja and Rodríguez-Estrella 2010), and fishes (*Cyprinus carpio* (Linnaeus, 1758), *Poecilia reticulata* (Peters, 1859), *Xiphophorus hellerii* (Heckel, 1848), and *Coptodon* cf. *zillii* (Gervais, 1848); Ruiz-Campos et al. 2014). While most cases of the colonisation of oases by exotic flora and fauna can be traced to anthropic origins, some can be attributed to "natural" causes, as they were generated by vectors like insects, birds, or mammals. Regardless of the circumstances of their arrival, the entry of exotic and invasive species is a dynamic process, as evidenced by the recent introduction of the exotic, invasive clam *Corbicula fluminea* (O.F. Müller, 1774) into the San Ignacio (SI) oasis. The objective of the present study is to formally report the first sighting of this species in BCS, Mexico.

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Study area

The SI oasis (Figure 1) is part of the basin of the same name, and both are in the Vizcaíno Hydrographic Region, which is completely isolated from other basins (Ruiz-Campos et al. 2014). The source of the water of the SI oasis is south of the San Francisco mountain range, which flows intermittently until it reaches the SI oasis itself, where it is dammed (Ruiz-Campos et al. 2006). The SI oasis is the largest and northernmost permanent body of freshwater in BCS and has an area of 2.69 km^2. It lies less than 5 km from the town of San Ignacio (Rodríguez-Estrella et al. 1999). This oasis presents few fluctuations in the water level because its subterranean hydric supply means that it does not depend on pluvial events. The substrate is basically sandy with muddy patches. The margins of the oasis are covered by riparian vegetation, bordered by palm trees and sarcocaulescent shrubbery (Ruiz-Campos et al. 2014).

Methods

The SI oasis was surveyed on 14–15 June 2025 to monitor the population of *Geothlypis beldingi*. During work on 14 June in the extreme northwestern area at the San Ignacio Dam (Figure 1), the presence of a bivalve mollusc was detected. The team collected by hand eight specimens of this clam and preserved them in commercial-grade ethanol at 96%. The collection site (−27.298, −112.897) was determined using a GPS receiver (Garmin). At the sampling point, a handheld BLE–C600 multiparameter device was used to measure pH (measuring interval 0.00–14.00, resolution 0.01, precision ±0.1), electrical conductivity (interval 0–9999 uS/cm 110.01–20.1 mS/20.1–400, resolution 0.1 mS/cm), and salinity (interval 0.00–9999 ppm, resolution 0.01 ppm). Samples of the clams were identified at the Bird Laboratory, Universidad Autónoma de Baja California Sur, using specialized literature (e.g. Bogan and Alderman 2008; Bogan and Ashton 2016).

The collected specimens are deposited in the Biological Collection of Invertebrates of the Centro Interdisciplinario de Ciencias Marinas – Instituto Politécnico Nacional (BCICICIMAR – IPN) in La Paz, Baja California Sur, Mexico.

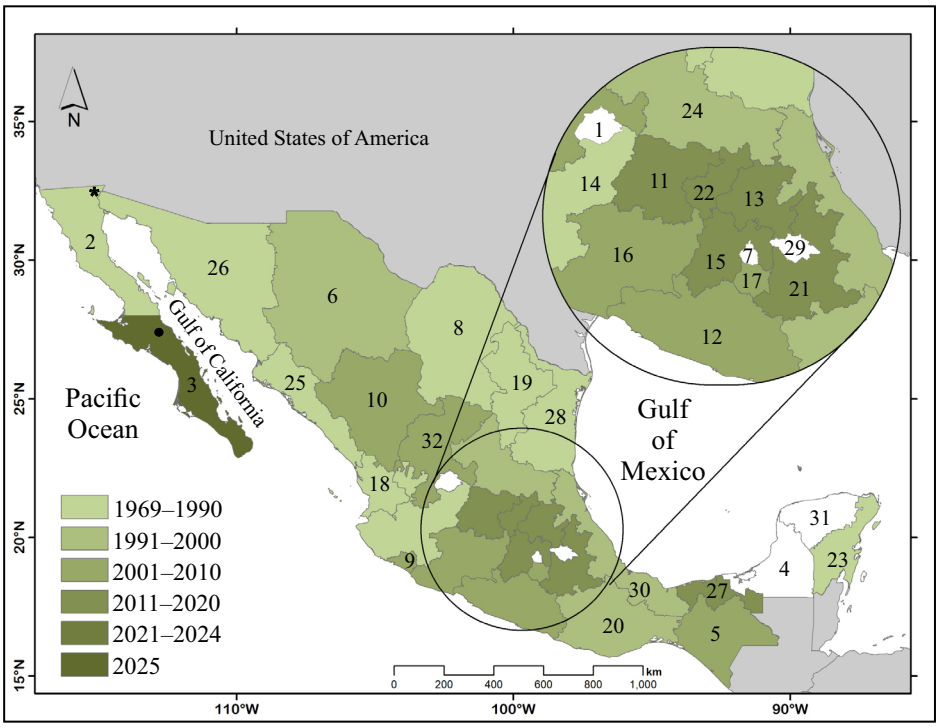

Figure 1. Distribution of *Corbicula fluminea* in Mexico and location of the San Ignacio oasis, Baja California Sur. Circle (●): new record. Asterisk (⋆): first record in Mexico. White states: species is unrecorded. Coloured states: recorded. States: 1 = Aguascalientes, 2 = Baja California, 3 = Baja California Sur, 4 = Campeche, 5 = Chiapas, 6 = Chihuahua, 7 = Ciudad de México, 8 = Coahuila, 9 = Colima, 10 = Durango, 11 = Guanajuato, 12 = Guerrero, 13 = Hidalgo, 14 = Jalisco, 15 = México, 16 = Michoacán, 17 = Morelos, 18 = Nayarit, 19 = Nuevo León, 20 = Oaxaca, 21 = Puebla, 22 = Querétaro, 23 = Quintana Roo, 24 = San Luis Potosí, 25 = Sinaloa, 26 = Sonora, 27 = Tabasco, 28 = Tamaulipas, 29 = Tlaxcala, 30 = Veracruz, 31 = Yucatán, 32 = Zacatecas.

Results

Bivalvia, Cyrenidae

***Corbicula fluminea* (O.F. Müller, 1774)**
Figure 2

New record. MEXICO — **Baja California Sur** • San Ignacio oasis, San Ignacio, Mulegé municipality, −27.298, −112.897; 120 m alt.; 15.VI.2025; David Carmona leg.; 8 spec., BCICICIMAR – IPN no. 544.

Identification. We identified the specimens as *C. fluminea*, which is known in Mexico and many other areas of the world as the Asian Clam. The principal morphological characteristics that allowed for identification were (i) concentric rings with high peaks in the periostracum of the center of the shell (Figure 2A–C), and (ii) three cardinal teeth under the umbos of each valve (Figure 2D, E). The eight specimens range in size: length = 8–23 mm, $\bar{x}$ = 15.8 mm, SD = 5.0; width = 5–12 mm, $\bar{x}$ = 13.1 mm, SD = 3.6; and height = 7–17 mm, $\bar{x}$ = 9.6, SD = 2.9 (Figure 2).

Remarks. Results from the collection site showed pH = 7.7, conductivity=1,200 mS/cm, and salinity = 0.05 ppm.

Discussion

Since its first record in Mexico some 50 years ago (Fox 1970), *Corbicula fluminea* has established itself across most of the country, with reliable records in 26 states (Tiemann et al. 2024), leaving only five states (Aguascalientes, Campeche, México City, Tlaxcala, and Yucatán) without records (Figure 1). Determining the chronology of the spread of *C. fluminea* in Mexico is difficult, as the routes of dispersal of the species are virtually unknown. However, it is assumed that dispersal has been through human activities in combination with natural phenomena. Understanding the dispersal of *C. fluminea* has been hindered by the lack of systematic monitoring programs (McMahon 2002; Tiemann et al. 2024). *Corbicula fluminea* was first confirmed in Mexico from the neighbouring state of Baja California. There, specimens were found in an irrigation canal near the town of Cerro Prieto (Figure 1), a little over 700 km north of the SI oasis (Fox 1970).

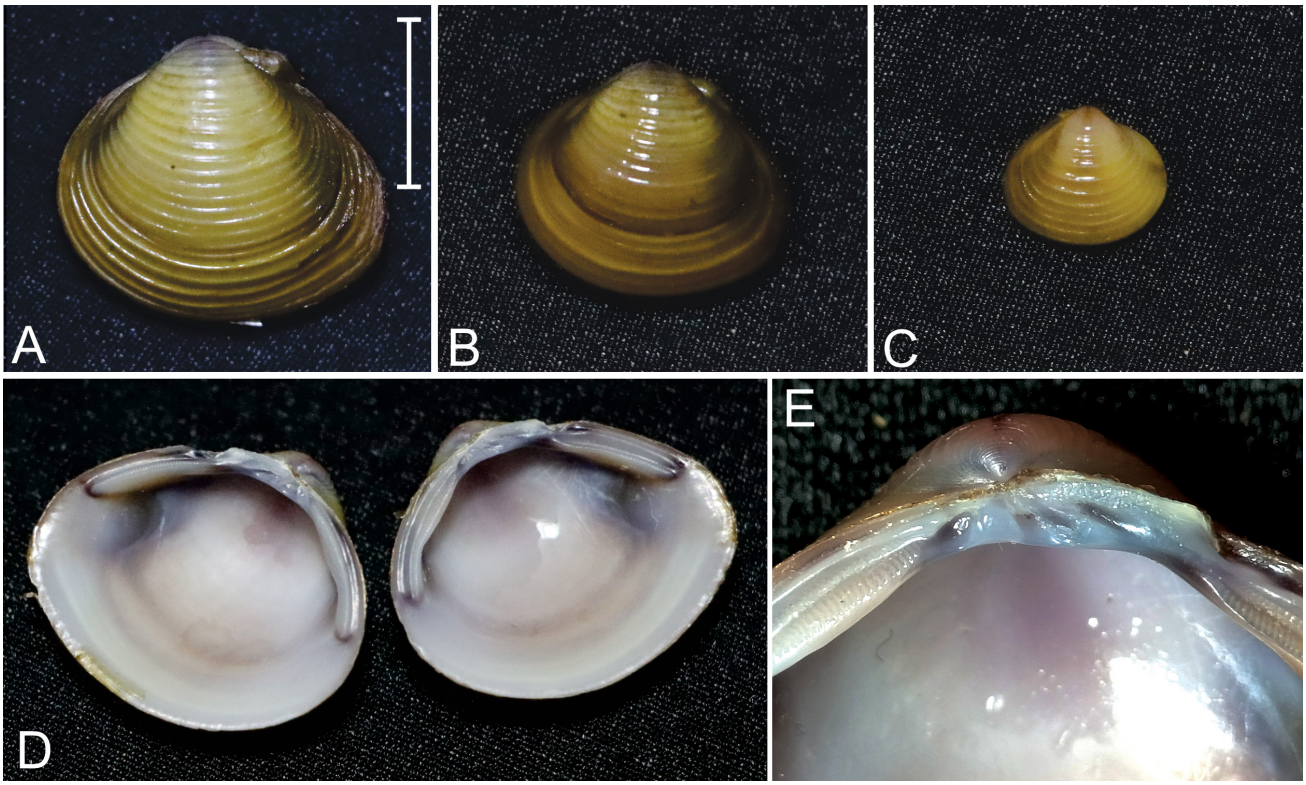

Figure 2. Specimens of invasive Asian Clams collected at the SI oasis showing: (**A**–**C**) the external, (**D**) internal view of shells and (**E**) close-up of three cardinal teeth directly below the umbos in each valve. Scale bar = 1 cm.

Internationally, *C. fluminea* is known to be transported mainly in ballast water or by adhering to the hulls of ships. While it can be used as bait in recreational fishing (GISD 2005), none of these conditions apply to the SI oasis because this water body is not used for navigation due to its small size and shallow depth, and bait fishing is not practiced. Prezant and Chalermwat (1984) suggested that downstream dispersion is facilitated by mucous strands, which are produced by *C. fluminea*; these act as trawl lines. However, this is also unlikely in the SI oasis because the oasis is fed by groundwater and is isolated from other bodies of water.

An alternative hypothesis for the dispersal of *C. fluminea* is external transport on the legs or wings of birds or insects (Prezant and Chalermwat 1984; Labaut-Betancourt 2000; Darrigran and Damborenea 2006; Darrigran and Dreher-Mansur 2006); therefore, we suggest that eggs, larvae, or even young *C. fluminea* may have become adhered to the legs or trapped in feathers of migratory birds (Green et al. 2002; López et al. 2019), such as Anatidae and sandpipers, groups that are common during the migratory and winter seasons in the SI oasis (Ruíz-Campos et al. 2014). This type of colonisation is a virtually unpredictable stochastic process. An additional possibility to explain the arrival of *C. fluminea* in the SI oasis is its transport and release by aquarists, as is known for other taxa (Duggan 2010). However, the San Ignacio town is small, with roughly 500 inhabitants (INEGI 2023). There are no specialized stores serving aquarists and, as far as is known, there are no aquarists in the town.

McMahon (1983) reported that *C. fluminea* reaches sexual maturity at 6.5–13.0 mm in length. Based on this information, the eight clams we collected can be considered mature, as they all exceed 6.5 mm, and six of them even exceed the maximum size. Thus, *C. fluminea* is an established alien in the SI oasis with a high potential to spread to nearby oases; according to the terminology proposed by Occhipinti-Ambrogi and Galil (2004), the mode of entry corresponds to an invasive alien of secondary introduction.

Corbicula fluminea has been classified as an invasive species in Mexico, presenting a very high-risk (Naranjo-García and Olivera-Carrasco 2014; CONABIO 2017). Based on the above, it is not difficult to predict its potential impact on oases in BCS in general, and in San Ignacio specifically, because it is already firmly established there. Among the principal negative effects of this species are its highly efficient filtration of the water column and severe, direct impact on phytoplanktonic communities by reducing the production of oxygen and nutrients. These impacts that have potential repercussions for all other species in the trophic network (GISD 2005). Worse yet, these effects could be multiplied due to the small surface area of this oasis and competition for food and space with native species, conditions that have the potential to diminish native species populations (CONABIO 2017). This could have a drastic impact on endemic species for which the oases in BCS constitute relict zones (Ruiz-Campos et al. 2006; Marrón and Carmona 2024). It is, therefore, urgent to design and apply a program to eradicate, or at least control, *C. fluminea* in the SI oasis, and to monitor all the oases on the Baja California Peninsula, primarily those around BCS.

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Additional information

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: RC, DC. Data curation: FOLF, DC, EF. Formal analysis: RC, DC, FOLF. Funding acquisition: RC. Investigation: RC. Methodology: FOLF, DC, EF. Writing – original draft: RC, FOLF. Writing – review and editing: RC, FOLF, DC.

Author ORCID iDs
Roberto Carmona https://orcid.org/0000-0002-7007-9063
Francisco Omar López-Fuerte https://orcid.org/0000-0002-0828-9107

Data availability
All data that support the findings of this study are available in the main text.

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