

An Invasion Tale: *Limnoperna fortunei* (Dunker, 1857) (Mytilidae) In The Neotropics

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Introduction

In the 1970s two Asiatic freshwater bivalves, *Corbicula largillierii* (Philippi) and *C. fluminea* (Müller) (Corbiculidae), entered South America along the Argentinean coast of the Río de la Plata (Ituarte 1981). In 1991, we detected, for the first time in America, the presence of a third Asiatic bivalve in the Río de la Plata estuary. This time, the invader species was the mytilidae *Limnoperna fortunei* (Dunker 1857). *L. fortunei* is a freshwater species found in rivers and streams of China and southeast of Asia (Morton 1977). It was found for the first time in the Americas in 1991, in a locality known as Bagliardi Beach, Río de la Plata river, Argentina (34° 52' 28'' S – 57° 48' 24'' W) (Pastorino *et al.* 1993). Still earlier, it had invaded the Hong Kong area in 1965 (Morton 1982); Japan (Kimura *et al.* 1999) and Taiwan (Morton 1997) in the '90s.

Darrigran and Pastorino (1995) proposed that this species was unintentionally introduced in the ballast water of ships, from Asia to America. *L. fortunei* populations are found all over hard substrates such as trunks, roots and stones even on those placed artificially to keep the coast limits. The eurihaline character of *L. fortunei* likely facilitates its rapid spread. The impact of *L. fortunei* is important in human and natural environment. The biofouling problems caused by *L. fortunei* and the impact on the native mollusc community in South America are similar to those described for *Dreissena polymorpha*, "zebra mussel", in the Northern Hemisphere (Darrigran 1995, Ricciardi 1998, Darrigran and Ezcurra-de-Drago, in press). The invasion of the bivalve *L. fortunei* in this area as well as its distribution in the Neotropics, and the reproductive cycle of this population, are analyzed in this contribution.

Study Area

One of the most important hydrographic system of South America is the Plata Basin, with a drainage area of approximately 3,000,000 square kilometers, and comprises four main sub-basins (Bonetto, 1994): [1] the Uruguay River; [2] the Paraná-Paraguay system; [3] the Río de la Plata estuary; and [4] the Andean tributaries (Figure 1). The rivers of this basin travel through tropical, subtropical and temperate areas. Which involve forest, pasture ("la Pampa") and Andean mountains ("los Andes"). Moreover, this basin involves five countries (Figure 1).

Results And Discussion

L. fortunei, between 1991 and 1999 adapted to a wide variety of environments including the euryhaline habitats in the estuary of the Río de la Plata, and the freshwater habitat along the Plata Basin.

This bivalve invaded three of the Plata Basin main rivers, the Río de la Plata, Paraná river and Paraguay river.

L. fortunei invaded four countries: Argentina – 1991; Uruguay – 1995 (Scarabino y Verde 1995 (1994)); Paraguay – 1998 (Darrigran and Ezcurra de Drago, in press); and Brazil – 1999 (Figure 1) (Dreher Mansur *et al.*, 1999). Since 1991, it has colonized 1,100 km through the plata basin. *L. fortunei*, traveled up to the rivers about 240 km per year (Darrigran and Ezcurra de Drago, in press). The high biotic potential, the absence of competitive interaction and the fact that is the only species with epifaunal habit on the plata basin, permit us to define *L. fortunei* as an invasive species.

The biofouling problems caused by *L. fortunei* in South America were detected in drinking-water, industrial and power-generating plants, and can be summarized as follows: reduction of pipe diameter blockage of pipeline; decreased water velocity caused by friction loss; accumulation of empty shells; contamination of water pipelines by mass mortality; and filter occlusion.

The impact of *L. fortunei* is not restricted to economical aspect. Among the problems associated with the presence of this fouling animal, it has been demonstrated that the community is rapidly changing. The specific diversity of invertebrates (mainly oligochaeta and hirudinea) is favored by the presence and abundance of the mussel, while indigenous mollusks are generally constrained and displaced (Darrigran *et al.* 1998a).

Year	Densities (m ²)	Reference
1991	5 individuals	Darrigran & Pastorino (1995)
1992	30,000 ind.	Darrigran & Pastorino (1995)
1993	80,000 ind.	Darrigran & Pastorino (1995)
1995	150,000 ind.	Darrigran, et al. (1998a)

Before the introduction of *L. fortunei* in Bagliardi Beach, 3 gastropods were commonly found: *Heleobia piscium* (d'Orbigny), *Chilina fluminea* (Maton), and *Gundlachia concentrica* (d'Orbigny). After the introduction of *L. fortunei*, *Ch. fluminea* and *G. concentrica* the presence are accidental (Figure 2). By contrast, there are new occurrences in this environment which correspond to species of Annelida (Oligochaeta - 8 species-; Hirudinea - 8 species-), Crustacea and Insecta. The epizotic colonization of a native bivalve (*Anodontites trapessialis* (Lamarck) (Figure 3) and the invader bivalve *Corbicula fluminea* (Figure 4)) by *L. fortunei* is common. This impact is similar to that caused by *Dreissena polymorpha* on unionids (Ricciardi 1998; Darrigran and Ezcurra de Drago, in press).

Between July '92 and November '94, we studied the reproductive cycle of a population of *L. fortunei* from Bagliardi Beach at Rio de la Plata (Darrigran *et al.* 1999). This locality is characterized by temperate environmental conditions, where water temperature vary between 10 and 24°C. *L. fortunei* is a dioecious species. Unlike Morton (1982), we found 0.55% of hermaphrodites (Darrigran *et al.* 1998b). However hermaphrodite species occur frequently in other mytilids, before this study no cases of hermaphrodites have been reported. The hermaphrodite specimens have three kinds of follicles: male, female and with both types of gametes.

We can identify two periods, characterized by different reproductive patterns (Figure 5). During the first period, two evacuations of low intensity were recorded from September 1992 to February 1993. They were associated to a partially stable follicular occupation of the mantle and the proliferation was continuous. During the second period, since February 1993, two main spawning events were recognized: the first one was in May-July 1993; the second in April-June 1994. Between these spawning peaks we also observed a smaller one during February-March 1994. However, unlike what Morton (1982) recorded in Hong Kong, no clear periods of gonadal inactivity were recorded after any of the evacuation processes.

Acknowledgements

The work was supported by the grants of the Agencia Nacional Promoción Científica y Tecnológica (PICT98 N°01-03453) and Fundación Antorchas (Programa de Cooperación Científico-Académica). We wish to express our thanks to Renata Claudi and Elizabeth Muckle-Jeffs for the help and assistance.

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Figure 1. Studied localities.

■ Bagliardi Beach; * first report in Brazil grey line: area colonization. [date]: Confirmed date sighting.

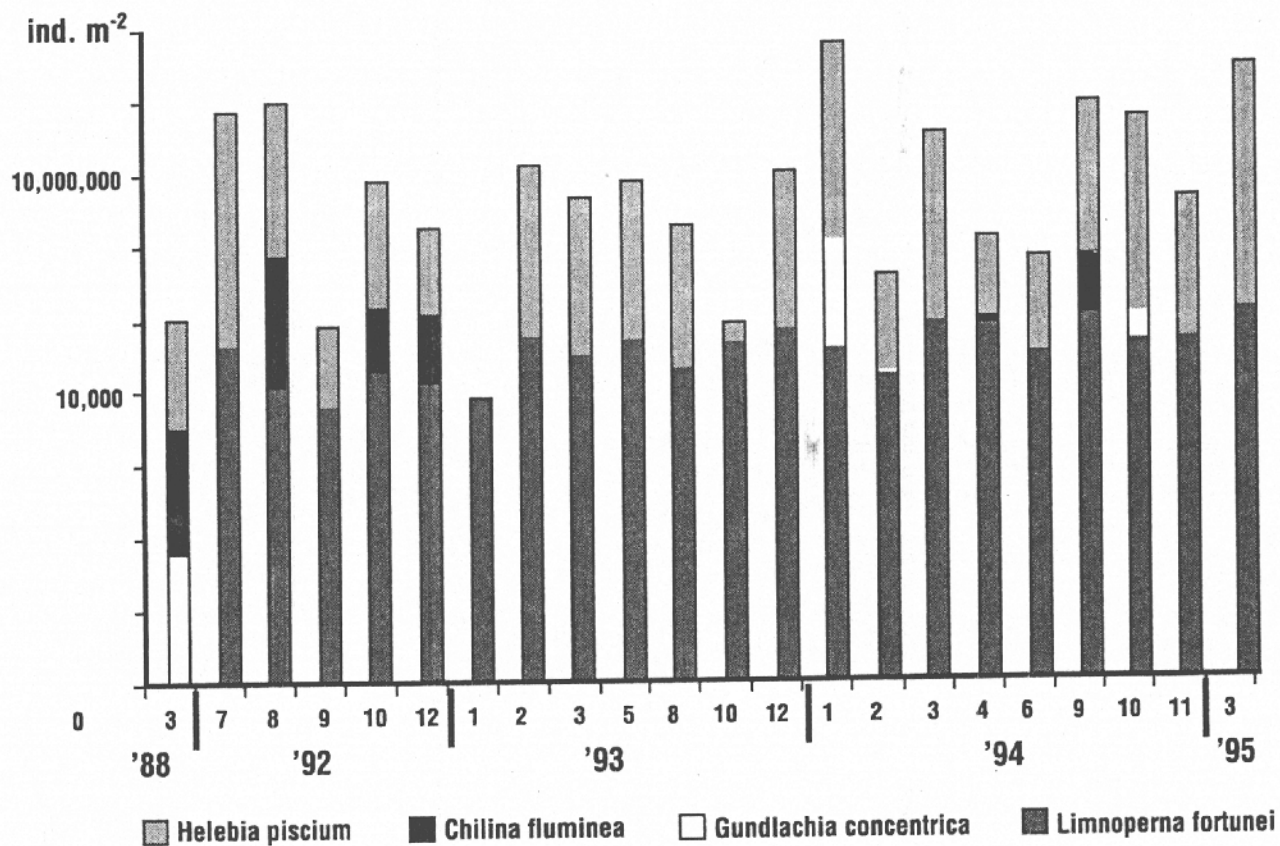


Figure 2. Temporal variation of density (ind per m²), of the native malacofauna associated with the byssus of *L. fortunei* in Bagliardi Beach (34° 52'28''S – 57° 48'24''W), Argentina.

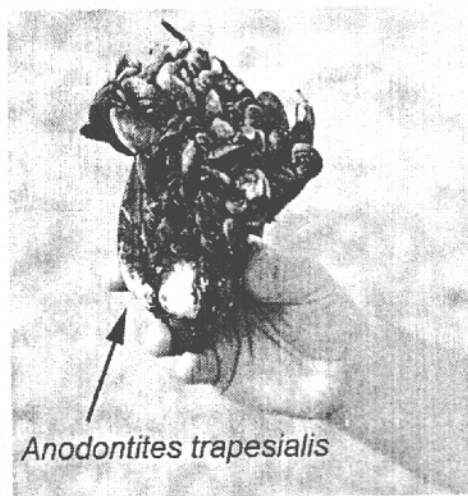


Figure 3. *L. fortunei* on a native bivalve.

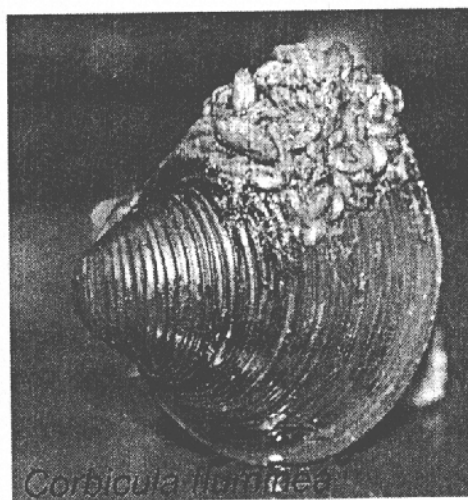


Figure 4. *L. fortunei* on another invasive bivalve.

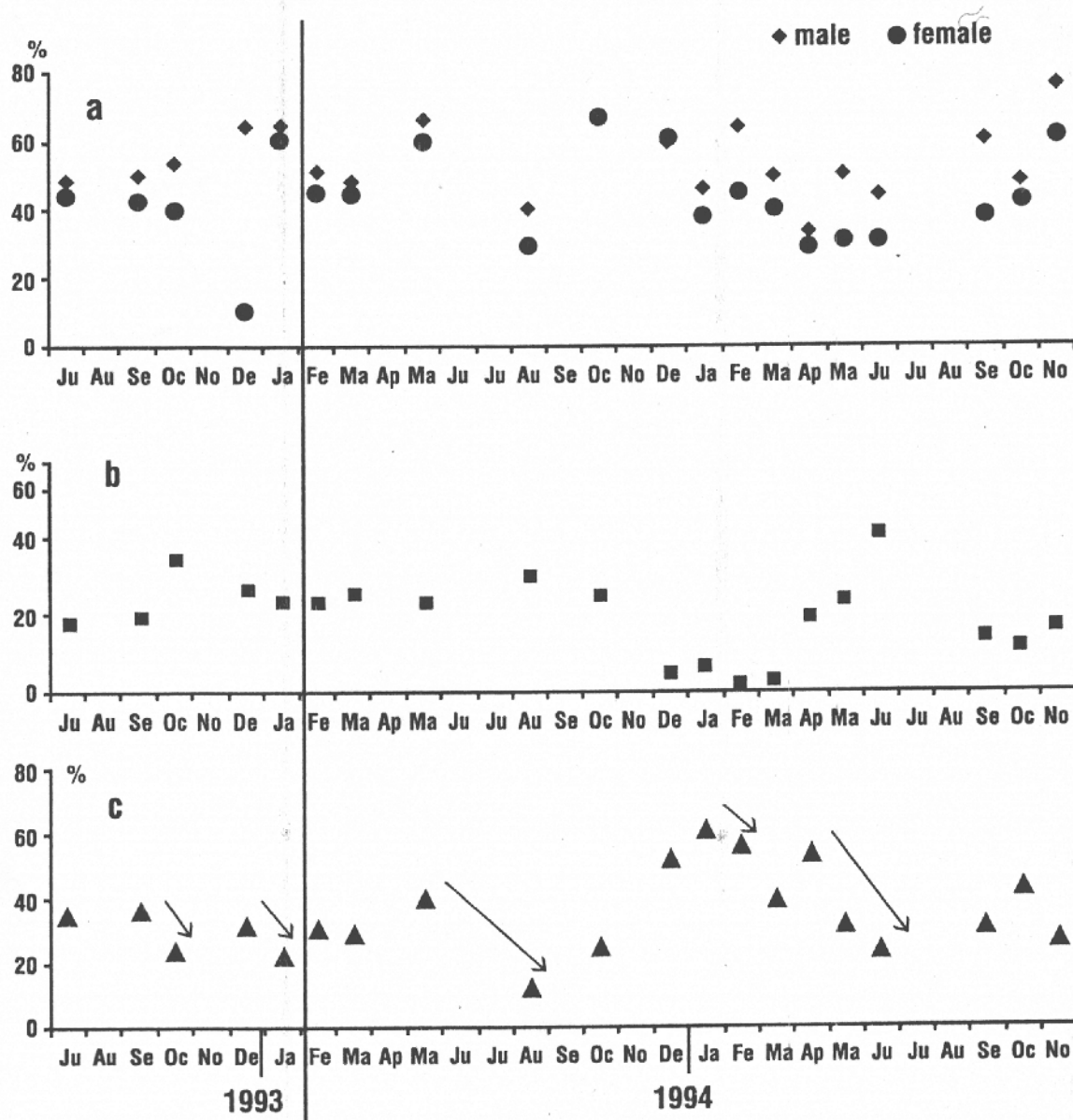


Figure 5. Temporal gonadal development of *L. fortunei* from Bagliardi Beach.