



Dreissena!



The Digest of

NATIONAL AQUATIC NUISANCE SPECIES CLEARINGHOUSE

Dreissena!

ISSN 1065-8408

Established 1990

Charles R. O'Neill, Jr., Director and Editor
Diane J. Oleson, Editorial Research Assistant
David B. MacNeill, Contributing Editor

Dreissena! is published six times per year by the Sea Grant's National Aquatic Nuisance Species Clearinghouse, a project of New York Sea Grant. *Dreissena!* presents information on research, meetings, legislation and sightings of zebra mussels (*Dreissena* spp.), and other important aquatic nuisance species, to encourage and facilitate communication among researchers and stakeholders.

Submissions for publication

Submissions for publication in *Dreissena!* are encouraged. Please direct correspondence to:

Editor, *Dreissena!*
National Aquatic Nuisance Species Clearinghouse
New York Sea Grant
Morgan II
SUNY College at Brockport
Brockport, NY, 14420-2978

Telephone: 716/395-2516

800/285-2285

Fax: 716/395-2466

E-mail: zmussel@cornell.edu

Web site at: <http://ccc.cornell.edu/scagrant/nanse>

The Clearinghouse is a public, nonprofit organization funded by: the National Sea Grant College Program of the National Oceanic and Atmospheric Administration, and electric utilities and industries throughout North America. The Clearinghouse was founded in 1990.

Subscription

To subscribe, use the order form on the inside back cover. Send orders and changes of address to the Clearinghouse. Back issues and replacement copies are available. Requests should be sent to the Clearinghouse.

Subscriptions to *Dreissena!* run for six regular issues. If you have any questions about your subscription, please call the Clearinghouse.

Postmaster, please send address changes to the Clearinghouse at the above address.

Scientific Advisory Board:

Dr. James Carlton,

Williams College, Mystic Seaport Maritime Studies Program

Dr. Andrew Cohen,

San Francisco Estuary Institute

Dr. Robert McMahon,

Center for Biological Macrofouling Research, University of Texas

Dr. Edward Mills,

Department of Natural Resources, Cornell University

Dr. Gregory Ruiz,

Smithsonian Environmental Research Center

© Copyright 2000, New York Sea Grant



National ANS Clearinghouse
New York Sea Grant Extension
Morgan II
SUNY College at Brockport
Brockport, NY 14420-2928

Funding for the Clearinghouse is provided by the Great Lakes Sea Grant Network, the New England Sea Grant Network, the Mid-Atlantic Sea Grant Network, the National Sea Grant College Program of the National Oceanic and Atmospheric Administration, and electric utilities and industries throughout North America.

SEA GRANT ZEBRA MUSSEL/ANS CONTACTS

For additional local information concerning zebra mussels, or other aquatic nuisance species please contact the Sea Grant office in your area.

National Aquatic Nuisance Species Clearinghouse

New York Sea Grant
Charles R. O'Neill, Jr.
Brockport, NY
Voice: (716)395-2516
Voice: (800)285-2285
Fax: (716)395-2466
E-mail: zmusssel@cornell.edu

Alabama Sea Grant
Richard K. Wallace
Mobile, AL
Voice: (334)438-5690
Fax: (334)438-5670
E-mail: rwallace@acesag.auburn.edu

Connecticut Sea Grant
Nancy Balcom
Groton, CT
Voice: (860)405-9127
Fax: (860)405-9109
E-mail: balcom@uconnvm.uconn.edu

Delaware Sea Grant
James M. Falk
Lewes, DE
Voice: (302)645-4235
Fax: (302)645-4007
E-mail: james.falk@mvs.udel.edu

Florida Sea Grant
Marion Clarke
Gainesville, FL
Voice: (904)392-1837
Fax: (904)392-5113
E-mail: mlc@gov.ifas.ufl.edu

Illinois-Indiana Sea Grant
Patrice Charlebois
Zion, IL
Voice: (847)872-0140
Fax: (847)872-8679
E-mail: patricec@ix.netcom.com

Louisiana Sea Grant
Michael Liffmann
Baton Rouge, LA
Voice: (504)388-6290
Fax: (504)388-6331
E-mail: eoslif@lsuvm.sncc.lsu.edu

Maine/New Hampshire Sea Grant
Julia Dahlgren
Durham, NH
Voice: (603)749-1565
Fax: (603)743-3997
E-mail: juliadahlgren@unh.edu

Maryland Sea Grant
Daniel E. Terlizzi
Annapolis, MD
Voice: (410)267-5660
Fax: (410)267-5666
E-mail: daniel_e_terlizzi@umail.umd.edu

Michigan Sea Grant
John Schwartz
East Lansing, MI
Voice: (517)353-9568
Fax: (517)353-6496
E-mail: schwartj@msuc.msu.edu

Minnesota Sea Grant
Doug Jensen
Duluth, MN
Voice: (218)726-8712
Fax: (218)726-6556
E-mail: djensen@mes.umn.edu

Mississippi Sea Grant
C. David Veal, Ph.D.
Biloxi, MS
Voice: (228)388-4710
Fax: (228)388-1375
E-mail: cdv@ra.msstate.edu

MIT Sea Grant
Judith Pederson
Cambridge, MA
Voice: (617)252-1741
Fax: (617)252-1615
E-mail: jpederso@mit.edu

New Jersey Sea Grant
Eleanor A. Bochenek
Fort Hancock, NJ
Voice: (732)872-1300
Fax: (732)872-9573
E-mail: eleanor@njmse.org

New York Sea Grant
Charles R. O'Neill, Jr.
Brockport, NY
Voice: (716)395-2638
Fax: (716)395-2466
E-mail: cro4@cornell.edu

North Carolina Sea Grant
Barbara A. Doll
Raleigh, NC
Voice: (919)515-2454
Fax: (919)515-7095
E-mail: barbara_doll@ncsu.edu

Ohio Sea Grant
Karen Ricker
Columbus, OH
Voice: (614)292-8949
Fax: (614)292-4364
E-mail: ricker.15@osu.edu

Rhode Island Sea Grant
Michael Rice
Kingston, RI
Voice: (401)874-2943
Fax: (401)874-4017
E-mail: rice@uriacc.uri.edu

South Carolina Sea Grant
Richard M. DeVoe
Charleston, SC
Voice: (803)727-2078
Fax: (803)727-2080
E-mail: devoemr@musc.edu

Wisconsin Sea Grant
Allen Miller
Madison, WI
Voice: (608)262-0644
Fax: (608)263-2063

Woods Hole Oceanographic Institution Sea Grant
Woods Hole, MA
Voice: (508)289-2557
Fax: (508)457-2172
E-mail: jmcowell@whoi.edu

Invasive Freshwater bivalves of the Neotropical Region

Investigator: Gustavo Darrigran, Facultad de Ciencias Naturales y Museo, Universidad Nacional La Plata. Paseo del Bosque (1900) La Plata, Argentina. E-mail: invasion@way.com.ar; or invasion@museo.fcnym.unlp.edu.ar. Group for Research on Invasive Molluscs. <http://www.way.com.ar/~invasion>

Introduction

Since the 1960's, three species of freshwater bivalves: *Corbicula fluminea* (Müller) or "Asiatic clam", *C. largillierti* (Philippi) (Corbiculidae) and *Limnoperna fortunei* (Dunker) or "golden mussel" (Mytilidae), from the southeast of Asia, have reached the neotropical Plata Basin through the Río de la Plata (Table 1).

Limnoperna fortunei (Dunker, 1857)

The golden mussel is native to rivers and creeks from China and southeastern Asia. It invaded Hong Kong in 1965, Japan and Taiwan in the 1990's. Darrigran and Pastorino (1995) proposed the non-intentional introduction of this species into America in 1991, through ballast water of ocean vessels. Fig.1 shows the trade between Argentina and two countries where golden mussel inhabits.

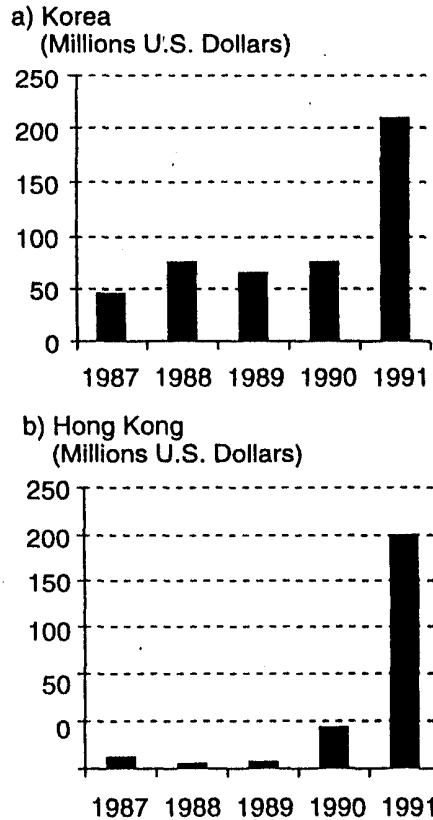


Figure 1. Trade between Argentine - Korea (a) and Hong Kong (b) (taken from Darrigran and Pastorino, 1995).

Table 1. Exotic bivalves in the Plata Basin.

	<i>Limnoperna fortunei</i>	<i>Corbicula fluminea</i>	<i>C. largillierti</i>
Origin	Southeastern Asia	Southeastern Asia	Southeastern Asia
Mode of life	Byssal epifaunal	Infaunal	Infaunal
Maximal Size	35 mm	42 mm	33 mm
Longevity	36 months	36 months	30 months
Sexuality	Dioecious	Hermaphrodite	Hermaphrodite
Development	Free	Branchial incubation	Branchial incubation
Introduction (way, place and date of entrance)	* Non intentional. In ballast water of ocean vessels *Río de la Plata- 1991	*Non intentional *Río de la Plata – end of the sixties, beginning of the seventies	*Non intentional * Río de la Plata – end of the sixties, beginning of the seventies
First cite	Pastorino, <i>et al</i> , 1993	Ituarte, 1981	Ituarte, 1981

Description of the Shell (Morton, 1973)

The shell of *L. fortunei* is equivalve and heteromyarian. It is dark brown above the umbonal keel and paler yellow-brown below. This is caused by the nacre of the interior of the shell being purple above and white below the keel. The presence of a nacreous layer in *Limnoperna* displaces this genus from all contact with Dreissenacea.

The outer periostracal layer of the shell is smooth and shiny and where it curls inwards at the shell margin is thick. The umbones are very nearly terminal and the

dorsal ligamental margin is straight or, at most, only slightly curved. The ventral margin of the shell is the most variable feature and in different specimens varied between the two extremes of being either straight or distinctly arcuate. There are no hinge teeth and no byssal notch. The shells are yellow-brown. In places with transparent water, for example in northern Argentina, they look golden; so it is called "golden mussel".

The golden mussel is epifaunal. It attaches to every natural hard substrate available (from trunks and aquatic plants to compact silt-sand) or artificial ones (piers, tubes, walls, etc.). Its eurioic status allows a quick and effective distribution in body waters.

The following features of the golden mussel make it an invasive species:

- its high biotic potential. In 1991, when it was first detected in Bagliardi Beach (Fig.2), its density was 4 to 5 individuals / m². Today in the same environment, its density is approximately 150,000 ind./ m²;
- the absence of competition;
- being the only epifaunal bivalve to achieve these high densities;
- the problems caused both to natural and human environments.

biofouling problems caused by *L. fortunei* in South America are similar to those described for *Dreissena polymorpha*, "zebra mussel", in the Northern Hemisphere (Darrigran and Ezcurra de Drago, in press).

Impacts of this species are felt in both human and natural environments. The Plata Basin is one of the most important hydrographic systems in South America (Fig.2), with a drainage area of nearly 3 million km², formed by 4 sub-basins. Its rivers flow through tropical, subtropical and temperate areas. It includes forests, grasslands (the Pampa) and mountains (the Andes) and covers 5 countries, 4 of which take part in the economic system called MERCOSUR.

Since its introduction, the golden mussel has greatly extended its distribution, and despite the important problems that it causes, people are not aware of the environmental impact.

The increase of the spatial distribution within these years, may be summarized as following:

1. It invaded two of the four sub-basins (Fig.2). In 1991 it inhabited only the Río de la Plata; currently it is also in the sub-basin of the Paraná and Paraguay rivers.
2. In 1995, on the Paraná river it was recorded up to the locality of Zárate (Buenos Aires province). Currently it reaches the city of Posadas, in Misiones province.
3. Until 1995 it was recorded in a single country, Argentina. Currently it also inhabits Paraguay, Uruguay and Brazil (Fig. 2).

In sum, the golden mussel has moved forward over 240 km per year, since its introduction. From 1991 to the present, it has settled in approximately 1,100 km along the Plata Basin.

Since the introduction of the golden mussel in the Río de la Plata, the group for research on invasive molluscs of the Universidad Nacional de La Plata which I lead, carries on investigations on population dynamics, their impact on native species (Darrigran, *et al*, 1998); distribution (Darrigran and Ezcurra de Drago, in press); reproductive biology (Darrigran, *et al*. 1998; Darrigran, *et al*. 1999); larval development (Ezcurra de Drago, *et al*. MS); indi-

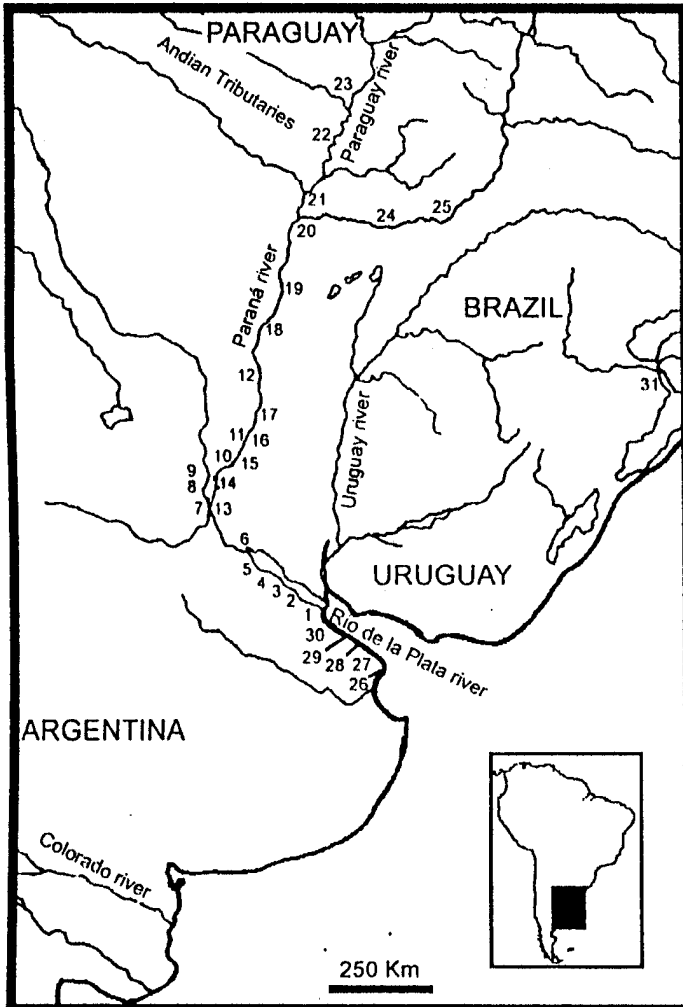


Figure 2. The Plata (4 sub-basins: Río de la Plata river; Uruguay river; Parana-Paraguay rivers and Andean tributaries) and Colorado River Basins. 1 to 31: Localities where *L. fortunei* is found.

1 Campana	16 Santa Elena
2 Baradero	17 La Paz
3 San Pedro	18 Esquina
4 Ramallo	19 Goya
5 San Nicolás	20 Corrientes
6 Villa Constitución	21 Isla del Cerrito
7 Rosario	22 Formosa
8 San Lorenzo	23 Asunción
9 Coronda	24 Ituzaingo
10 Santa Fe	25 Posadas
11 Helvecia	26 Punta Piedras
12 San Javier	27 Punta Indio
13 Victoria	28 Magdalena
14 Diamante	29 Bagliardi Beach
15 Paraná	30 Anchorena
	31 Lago Guaíba

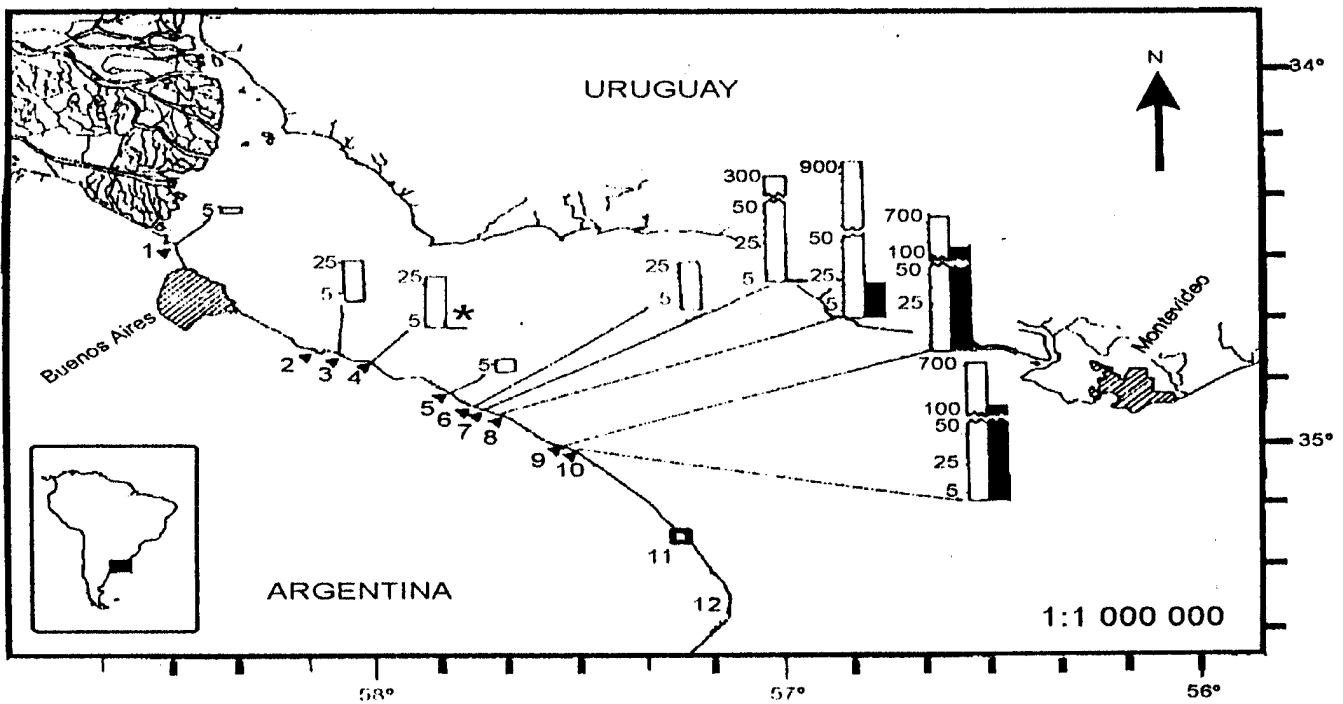


Figure 3. Distribution of the genus *Corbicula* in the Argentine coast of the Río de la Plata. Bar diagrams represent number of individuals / m². Black bars: *C. largillierti*; White bars: *C. fluminea*. *: presence of *C. fluminea*.+: occasional presence of *C. fluminea*. (modified from Darrigran, 1992b)

vidual growth (Maroñas, *et al.* MS) and predation (Penchaszadeh, *et al.*, in press). These researches aim to supply the necessary information for their prevention and control.

Fouling problems already caused by the golden mussel in South America were detected in the industries established along the Río de la Plata and Paraná rivers; mainly in the water intakes of plants for drinking water, industries and electric power plants.

The major problems caused by larval invasion, settlement and maturity, into water distribution systems (Nalepa and Schoclessor, 1993) are generally similar to problems which have already been detected in Argentina (marked with (X))

- * (X) Reduction of pipe diameter
- * (X) Blockage of the pipeline
- * (X) Decreased water velocity caused by friction (turbulent flows).
- * (X) Accumulation of empty shells
- * Contamination of water pipelines by mass mortality
- * (X) Filter occlusion

All these macrofouling problems were, up to the invasion of golden mussel, exclusive to the marine environment and absent in freshwaters of South America.

From a biological-environmental standpoint, in order to prevent and control the golden mussel, its strong adaptive-reproductive capacity must be considered. In the present distribution it passed through a temperate to a sub-tropical climate and is going to a tropical one. In addition to the changes of biological rhythm in populations when invading new natural environments, typical features of the human environment (the use, water velocity, system structure, etc.) must be taken into account.

These traits, similar to those of the zebra mussel in the Northern Hemisphere, are the reason why there is not a single effective method for prevention / control. On the contrary, it is necessary to have a dynamic assemblage of methods that reflect the particular natural and human environment.

The impact of the golden mussel is not restricted to economic impacts alone. Among the problems related to the presence of the invasive bivalve, the quick change in the benthic community, favoring the presence of *Oligochaeta* and *Hirudinea*, as well as the displacement of

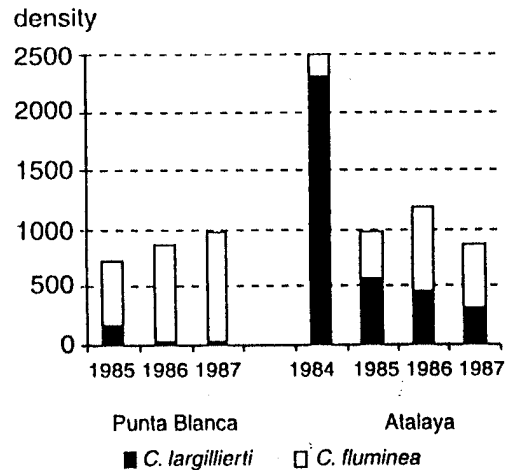


Figure 4. Densities of *C. fluminea* (white bars) and *C. largillierti* (black bars) in two coastal localities of the Río de la Plata. (taken from Darrigran, 1991).

indigenous species of molluscs (Darrigran, *et al.* 1998), is mentioned. Before the introduction of the golden mussel in Bagliardi Beach, three gastropods were commonly found: *Heleobia piscium* (d'Orbigny), *Chilina fluminea* (Maton), and *Gundlachia concentrica* (d'Orbigny). Since the introduction of the invasive bivalve, *Ch. fluminea* and *G. concentrica* have become rare.

Another example of the impacts on the malacofauna of the area is the settlement of the golden mussel on native bivalves, i.e. *Anodontites trapesialis* (Lamarck) and on the invasive bivalve *Corbicula fluminea*. These kinds of impacts on the benthic fauna are similar to those caused by *D. polymorpha* on native bivalves of the Northern Hemisphere.

Relative to native fish species, different authors (Penchaszadeh, *et al.*, in press; Montalto *et al.*, 1999) mentioned the presence of *L. fortunei* as a new element in the diet of these species and it constitutes the main food items for *Leporinus obtusidens* (Anostomidae).

Since the introduction of *L. fortunei* in South America, this species has demonstrated great dispersal ability. This trait, combined with the large volume of trade among Asia, South America and North America, emphasizes Ricciardi's (1998) assertion of the need for better and more effective ballast-water controls.

***Corbicula fluminea* (Müller, 1774) - *C. largillierti* (Philippi, 1811)**

The genus *Corbicula* (Megerle) is another taxon unintentionally introduced into the Neotropical Region exhibiting a quick and continuous expansion. Ituarte (1981) documented the presence of both, *C. largillierti* and *C. fluminea*, first for South America in the Río de la Plata, and estimated the date of introduction as the end of the 1960's and beginning of the 1970's. Veitenher-Mendes (1981), mentioned the first record of this genus in Brazil, and estimated it entered by the beginning of the 1970's. Veitenher-Mendes and Olazarri (1983) reported *Corbicula* sp. in the Uruguay Republic; their first collection was in 1979. The presence of *Corbicula* spp. is also esteemed highly probable in Bolivia and Perú.

Darrigran (1992a) reports that in 1985, *C. fluminea* and *C. largillierti* entered in lotic and lentic environments adjacent to the estuary of the Río de la Plata. Currently the genus *Corbicula* is distributed along the main rivers of the Plata Basin, in Río de la Plata, Paraná and Uruguay rivers (Darrigran, 1992b). In addition, it was found outside the Plata Basin. It has been found in a sandy shore of the Colorado River (39° 01' S - 64° 01' W), along the northern border of Patagonia (Cazzaniga, 1997) (Fig.2).

At the beginning of the 1980's (Ituarte, 1981) C.

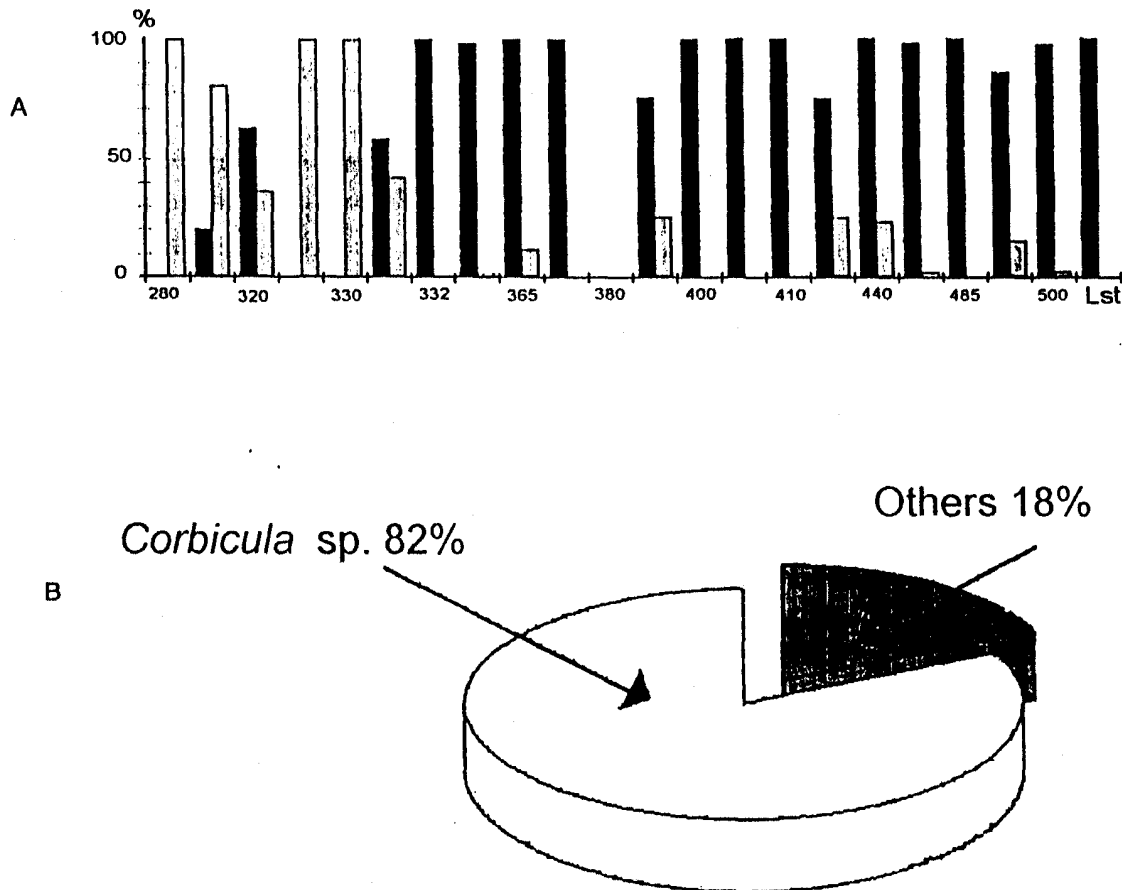


Figure 5. *Pterodoras granulosus* as a predator of *Corbicula* spp.
 (a) Relationship between size (Lst) of the captured *P. granulosus* and weight (%) of different items. *Corbicula* spp.: black bar; other items: white bar.
 (b) Percentage of shell weight of *Corbicula* spp. and of the alimentary items in total contents of the studied fish.

largillerti occupied a continuous strip of the Río de la Plata coast, from its head (33°53'S; 58°25'W) up to Magdalena Beach (35°01'S; 57°31'W), though it was not found in the affluent streams of the Río de la Plata. Likewise, *C. fluminea* was found only at the north of Buenos Aires Harbor (34°29'S; 58°28'W). Almost a decade later, Darrigran (1992b) reported the change of the distribution of the genus *Corbicula* in the Argentine coast of the Río de la Plata (Fig. 3). *C. fluminea* enlarged its distribution along the whole coast up to Punta Indio Beach (35°15'S; 57°08'W), while *C. largillerti*, formerly present along the whole coast, began to restrict its distribution range. In addition, Darrigran (1992a) said that *C. largillerti* prevailed in density over *C. fluminea* in those environments with silty substrate (streams and lentic water bodies, close to the Río de la Plata) which contrast with the typically sandy sediments of the coast of the Río de la Plata.

Such an increase in the distribution of *C. fluminea*, caused a competitive interaction between both species. Darrigran (1991) analyzed the temporal variation of densities of both species when co-inhabiting in two localities from the Argentine coast of the Río de la Plata: Punta Blanca (34°56'S; 57°40'W) and Atalaya Beach (35°00'S; 57°33'W) (Fig.4). Between 1985 and 1988, the density of *C. largillerti* was very low, relative to that of *C. fluminea*. The hypothesis proposed is that *C. fluminea* is competitively better than *C. largillerti*. Currently, *C. fluminea* is found in lotic and lentic environments associated with the coast of the Río de la Plata. Likewise, *C. largillerti* is found only in some affluent streams, living with *C. fluminea*, with a lower density than the latter.

As well as occurring in the Holarctic Region, there are records of macrofouling caused by *C. fluminea* in the Neotropical Region (recently in south of Brasil).

In natural environments, Darrigran and Colauti (1994) pointed out the impact related to the dietary change of a native fish of the Plata Basin as a result of the invasion of *C. fluminea* (Fig. 5 a and b).

Acknowledgements

The work was supported by the grants of the Facultad Ciencias Naturales y Museo (UNLP), Fundación Antorchas (13816-3) and Agencia Nacional Promoción Científica y Tecnológica (PICT98 N°01-03453). I wish to express my thanks to Diane Oleson for the help and assistance.

Literature Cited

Lazzaniga, N. 1997. Asiatic clam, *Corbicula fluminea*, reaching Patagonia (Argentina). *Journal of Freshwater Ecology*, 12(4): 629-630.

Darrigran, G. 1991. Competencia entre dos especies de Pelecípodos invasores: *Corbicula fluminea* (Müller, 1774) y *C. largillerti* (Philippi, 1844) en el litoral argentino del estuario del Río de la Plata. *Biología Acuática*, 15(2): 214-215.

Darrigran, G. 1992a. Nuevos datos acerca de la distribución de las especies del género *Corbicula* (Bivalvia, Sphaeriacea) en el área del Río de la Plata, República Argentina. *Notas Museo La Plata*, 21 (Zool.210): 143-148.

Darrigran, G. 1992b. Variación temporal y espacial de la distribución de las especies del género *Corbicula* Megerle, 1811 (Bivalvia, Corbiculidae) en el estuario del

Río de la Plata, República Argentina. *Neotropica*, 38 (99): 59-63.

Darrigran, G. and D. Colautti. 1994. Potencial control biológico del molusco invasor *Corbicula fluminea* (Müller, 1774) en el Río de la Plata. *Com. Soc. Malc. Uruguay*, 7(66-67): 368-373.

Darrigran G. and G. Pastorino. 1995. The Recent Introduction of Asiatic Bivalve, *Limnoperna fortunei* (Mytilidae) into South America. *The Veliger*, 38(2): 183-187. California, USA.

Darrigran, G.; S.M. Martin; B. Gullo; and L. Armendariz. 1998. Macroinvertebrate associated to *Limnoperna fortunei* (Dunker, 1857) (Bivalvia, Mytilidae). Río de La Plata, Argentina. *Hydrobiologia*, 367:223-230. The Netherlands.

Darrigran, G.; M.C. Damborenea and P. Penchaszadeh. 1998. A case of hermaphroditism in the freshwater invading bivalve (Dunker, 1857)(Mytilidae) from its first American habitat (Río de la Plata, Argentina). *Iberus*, 16(2): 99-104. Spain.

Darrigran, G.; P. Penchaszadeh and M.C. Damborenea. 1999. The life cycle of *Limnoperna fortunei* (Dunker, 1857) (Bivalvia:Mytilidae) from a neotropical temperate locality. *Journal Shellfish Research*, 18(2): 361-365. USA.

Darrigran, G. and I. Ezcurra de Drago (in press). Invasion of *Limnoperna fortunei* (Dunker, 1857) (Bivalvia: Mytilidae) in America. *Nautilus*. USA.

Ezcurra de Drago, I., G. Darrigran and O. Oliveros. (MS). Development stages and ecology of *Limnoperna fortunei* (Dunker, 1857) larvae in the Middle Parana River (Mollusca, Mytilidae).

Ituarte, C. 1981. Primera noticia acerca de la introducción de pelecípodos asiáticos en el área rioplatense. *Neotropica*, 27 (77): 79-82.

Montalto, L., O. Oliveros; I. Ezcurra de Drago and L. Demonte. 1999. Peces del río Paraná Medio predadores de una especie invasora: *Limnoperna fortunei* (Bivalvia, Mytilidae). *Revista FABICIB*, 3: 85-101.

Maroñas, M., Darrigran, G., Sendra, E. and G. Breckon (MS). Shell growth of the "Golden Mussel", *Limnoperna fortunei* (Dunker, 1857) (Mytilidae), from a neotropical temperate locality. *Hydrobiologia*, The Netherlands.

Morton, B. 1973. Some aspects of the biology and functional morphology of the organs of feeding and digestion of *Limnoperna fortunei* (Dunker) (Bivalvia: Mytilacea). *Malacologia* 12(2): 265-281.

Nalepa, T. and W. Schloesser (ed.). 1993. *Zebra Mussels. Biology, impacts, and control*. Lewis Publishers, Florida. 508pp

Pastorino, G., G. Darrigran, S. Martin and L. Lunaschi. 1993. *Limnoperna fortunei* (Dunker, 1857) (Mytilidae), nuevo bivalvo invasor en aguas del Río de la Plata. *Neotropica* 39(101-102):34.

Penchaszadeh, P., G. Darrigran, C. Angulo, A. Averbuj, N. Brignoccoli, M. Brögger, P. E. A. Dogliotti and N. Pérez. (in press) Predation on the invasive freshwater mussel *Limnoperna fortunei* (Dunker, 1857) (Mytilidae) by the fish *Leporinus obtusidens* Valenciennes, 1846 (Anostomidae) in the Río de la Plata, Argentina. *Journal Shellfish Research*. USA.

Ricciardi, A. 1998. Global range expansion of the Asian mussel *Limnoperna fortunei* (Mytilidae): another fouling threat to freshwater systems. *Biofouling*, 13(2):97-106.