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Corbiculidae in the Pantanal: history of invasion in southeast and central South America and biometrical data*

by

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Abstract

The chronology of the invasion by *Corbicula* of the Central and the eastern part of South America is revised based on the literature and museum collection records. The occurrence of *Corbicula largillierti* (PHILIPPI, 1844) and *Corbicula fluminea* (MÜLLER, 1774) are reported for the first time for the northern part of the Pantanal of Mato Grosso, at the upper part of the Paraguay River, a tributary of the large Paraná Basin. Corbiculidae were sampled at three different localities, on the banks of the Cuiabá River, near Cuiabá, capital of Mato Grosso State. The highest population density was 192 i/m^2. The shell length of the sampled population of *Corbicula largillierti* varied between 5.42 and 17.53 mm and *Corbicula fluminea* varied between 14.74 and 27.33 mm. The age for the sampled specimens of *C. fluminea* was estimated to be near three years and the date of arrival of the species in the Pantanal is probably 1996 or 97. The relationship between shell length, heigh, width and weight (shell and wet tissues) was also calculated and multivariate ANOVA test revealed significant differences between the species. The standard curve for the weight and length relationship, reflecting growth, was estimated using the exponential pattern.

Keywords: **Corbiculidae, invasive species, byometry, Pantanal, South America.**

Resumo

A cronologia da invasão por Corbicula no leste e centro da América do Sul foi revisada com base na literatura e em registros de coleções de museus. A ocorrência de *Corbicula largillierti* (PHILIPPI, 1844) e *Corbicula fluminea* (MÜLLER, 1774) são registradas pela primeira vez para o norte do Pantanal de Mato Grosso, no curso superior da Bacia do Paraguai-Paraná. Corbiculidae foram amostradas em três diferentes locais, às margens do rio Cuiabá, próximos à capital do estado de Mato Grosso. A densidade populacional máxima foi de 192 i/m^2. O comprimento da concha dos exemplares amostrados variou entre 5,42 e 17,53 mm para *C. largillierti*, e 14,74 e 27,33 mm para *C. fluminea*. A idade estimada para *C. fluminea* é de três anos e a data de chegada desta espécie invasora no Pantanal foi provavelmente em 1996 ou 97. As relações entre comprimento da concha, altura, largura e peso total também foram calculadas utilizando análises de

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regressão e, a equação que define a correlação entre o comprimento da concha e o peso total, refletindo o crescimento, apresentaram um padrão exponencial. A aplicação da análise multivariada ANOVA revelou diferenças significativas entre as espécies.

Introduction

Corbicula fluminea (MÜLLER, 1774) originated in Southeast Asia was accidentally introduced to other countries at the beginning of the century, being detected today in several regions of Europe and majority of US states (COUNTS III 1985; ISOM 1986).

The rapid dispersal of the species in the United States, with the onset of serious macrofouling problems like clogging of canals and pipings, water pumps, industrial cooling systems and turbines of hydroelectric plants has led to the investment of more than one billion American dollars per year in research and projects aimed at the control and reduction of populations and the unclogging of infested conduits (ISOM 1986).

Corbiculidae were introduced into South America (Figure 1 and Table 1) at the beginning of the 1970s, almost simultaneously in Buenos Aires, Argentina, and in Southern Brazil (ITUARTE 1981; VEITENHEIMER-MENDES 1981). ITUARTE (1994) reviewed the distribution of *C. fluminea* and *C. largillierti* in the Paraná, Uruguay and La Plata Rivers. The northernmost records for the Uruguay river are: Santo Tome (Corrientes - Argentina) for *C. largillierti* and Fray Bentos (Soriano - Uruguay) for *C. fluminea*. For the upper course of the Paraná River there are records of *C. largillierti* and *C. fluminea* at Paso de La Patria (Corrientes - Argentina).

ITUARTE (1985) and CATALDO & BOLTOVSKOY (1999), estimated the annual growth of populations of *C. fluminea* respectively from Plata River and Delta of Paraná River, Argentina.

In South Brazil (Table 1 and Figure 1) the first investigations of the population density of *C. fluminea* were published by MANSUR et al. (1988). They recorded a densities of 5191 ind./m^2 at the swamps of the Ecological Station of Taim and surrounding areas at Mirim Lagoon, in southern Brazil. Later MANSUR et al. (1994) detected a population density of 4173i/m^2 in a dam at the lower part of Caí River, also in South Brazil.

A survey conducted by SERRANO et al. (1998) during the years between 1987 and 1995, reported 11 bivalve species for the northern Mato Grosso Pantanal region, however the authors did not detect any Corbiculidae.

The present paper reports the first records and preliminary data of the populations of two species, *C. fluminea* (MÜLLER, 1774) and *C. largillierti* (PHILIPPI, 1844) in the Cuiabá River, in the midwestern region of Brazil. The chronology of the invasion based on literature of the geographical distribution of the species, personal observations and museum collection records is also reported.

Material and methods

Material examined:

Corbicula largillierti (PHILIPPI, 1844):

BRAZIL, Mato Grosso State: Municipality of Rosário do Oeste, Cuiabá River-Station I, MCP 7713, 5 ex. 2 valvas, 7/IX/1998 C. CALLIL & R. BARBOSA leg; MCP 7714, 32 ex. 3 valvas, 31/VII/1999, C. CALLIL leg; Municipality of Várzea Grande, Cuiabá River-Station II, MCP 7715, 17 ex. 1 valve, C. CALLIL & R. BARBOSA leg; Santa Catarina State: Municipality of Joaçaba, Peixe River, 3 ex. MCP:4978, 7/XI/96, RICHINITTI et al. leg; Municipality of Piratuba, Peixe River, 15 ex. 1 valve, MCP 4979, 09/XI/96, RICHINITTI et al. leg; Municipality of Marcelino Ramos, Uruguay River, 37 ex. 28

valves MCP: 4980, XI/96, RICHINITTI et al. leg; Rio Grande do Sul State: Municipality of Itaqui, Ibicuí River, near bridge BR 472, MCNF 31132, 13 ex., 18/III/88 MANSUR et al. leg; Municipality of São Borja, Uruguay River, MCNF 30765, 12 ex. 19/III/88, J. OLAZARRI et al. leg.

Corbicula fluminea (MÜLLER, 1774):

BRAZIL, Mato Grosso State: Municipality of Santo Antônio do Leverger, Station III, MCP 7716, 6 ex. III/1998 M. WANTZEN leg; MCP 7717, 5 valves 01/VIII/1999, CALLIL et al. leg; Santa Catarina State: Munipality of Concordia, Jacutinga River, MCNF 34417, 7 ex. 6-9/II/95 W. KOCH leg.

ARGENTINA, Provincia de Entre Rios, Cólon, MCNF 31237, 2v., 16/III/88, J. OLAZARRI et al. leg.

Abbreviations: MCP - Mollusc collection of the Museu de Ciências e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; MCNF - Mollusc collection of the Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre.

Sampling area: The Cuiabá River, a tributary of the Paraguay River (belonging to the Paraná Basin), is one of the major water bodies draining the Pantanal region of Mato Grosso, located between parallels 16 and 22 and meridians 55 to 58. Its source is located in Serra Azul and its drainage basin occupies almost 100,000 km^2, with steep valleys occurring in the upper course in which a tributary, the Manso River, enters the left margin. Further down, close to the municipality of Cuiabá, wider valleys occur forming extensive floodplains (CARVALHO 1986). Rainfall is seasonal with maximum precipitation (250 to 300 mm) in the spring-summer (September to March) and less intense precipitation (less than 100 mm) in fall and winter (March to September). Minimum rainfall (5 mm) occurs during July (TARIFA 1986). The Pantanal region is an area whith seasonal fluctuations in water levels that can be characterised by the amplitude, frequency and predictability of the floodpulse (JUNK 2000).

Sampling sites: (Fig. 1) Three sampling stations were selected on different environmental characteristics of the region present.

Station I – municipality of Rosário do Oeste, is located along the main channel of the Cuiabá River, with well defined banks and a rocky bottom. This sampling point is located close to the source of the Cuiabá River.

Station II – Passagem da Conceição, municipality of Várzea Grande, is also located along the main channel of the river where there is pronounced widening with still well defined bank limits, rocky bottom, and some regions of sandy eddies. This sampling station is located upstream from the municipality of Cuiabá.

Station III – Municipality of Santo Antônio do Leverger has variable margin limits and is subjected to periodic flooding, with a entirely sandy bed. The main channel is relatively small and the left margin very shallow and broad. This sampling station is located downstream from the municipality of Cuiabá. The following physicochemical variables were determined: dissolved oxygen, electrical conductivity, pH, and air and water temperature, using equipment with specific sensors (WTW - Germany), during the survey day.

Sampling methods: Specimens were collected manually after being located in the sediment by probing with hand. Live collected individuals were anaesthetised with menthol, fixed in 4 % formalin and stored in 70 % alcohol. The population density of *C. fluminea* was performed only on Station III. One transect was made across the width of the river, along a distance of 25 m from the left margin to the main channel, equivalent to the half the width of the Cuiabá River. On the first 8 m the distance between each sampling point was one meter. From the point 8 to 25 the distance was

two meters, resulting in 16 sampling probes. Inside each sampling point corresponding to an area 25 cm^2, all individuals were collected.

Biometry: The following biometric parameters were considered: length (Lt), height (h) and, total weight (Wt) considering the shell and the wet soft parts. The measurements were made with a calliper and a precision analytical scale. For the shells that were empty, length and height measurements were made using the Image Tool software, version 2.0, developed by UTHSCSA - University of Texas Health Science Center, according to WILCOX et al. (1997). For the procedure, the inner view of the right valve was scanned, with a desktop scanner. The valve was oriented based on the impressions of the adductor muscles and the position of the beaks. Figure 2 shows how lines "h" (total height) and "Lt" (length) were projected according to the method of MANSUR et al. (1987) in order to obtain the length and height of each specimen in a precise manner.

Data analysis: The relationships between different pairs of variables were investigated by plotting scatter grams, to which regression equations were fitted and the coefficient of determination (r^2) was obtained. ANOVA tests was utilized to estimate the diferences between the species. To determine the patern of growth of the individuals within a population, the relationship between weight and length was used, which is commonly expressed by the exponential equation $Wt = a.Lt^b$, where "Wt" is weight and "Lt" is length, and a and b are estimates of the correlation parameters characteristic for the species, whose b suggests the growth coefficient (SANTOS 1978; VAZZOLER 1982; CALLIL 1989; PESO-AGUIAR & VERANI 1998).

Results

The records of invasion by *Corbicula* based on the literature and on the material examined in museum collections, allowed us to accompany the gradual range expansion of *Corbicula* along the rivers over three decades (Fig. 1, Table 1).

A total of 126 individuals were sampled considering all sites. From them, 86 specimens were identified as *C. largillierti* (29 of them alive and 57 empty entire shells) and 40 specimens as *C. fluminea* (21 of them alive and 19 empty entire shells). The descriptive statistics for the biometric variables obtained for the shells of *C. fluminea* and *C. largillierti* collected at different sampling sites are listed in Table 3.

Shell lengths of *C. fluminea* varied from 14.74 mm to 27.33 mm, of *C. largillierti* varied from 5.42 mm to 17.53 mm. Specimens of *C. fluminea* shows a greater mean length than *C. largillierti*. The differences between the species considering all variables (shell length - Lt, height - h, width - wi, and total weight - Wt) are significant according to multivariate ANOVA (Table 4).

The relationship between shell length x height (Table 5), shell length x width (Fig. 3) and shell length x weight (Fig. 4) revealed the differences among the species. The regression using shell length and weight, demonstrate an exponential growing pattern and is expressed mathematically at Table 6. The coefficient of determination (r^2) indicates a strong correlation between these variables, 93 % for *C. fluminea* and 79 % for *C. largillierti*.

Considering the population density of *C. fluminea* in the transect performed on Station III, a general low density prevailed (Table 2). The highest density of 12 ind. in the quadrat of 25 cm^2 (192 ind/m^2) was found on the margins in a depth of 5 cm and the individuals with a maximal size of 13.57 mm. The mean values were 2.31 ind. per

25 cm^2.

Discussion

Until now there were no records of *Corbicula fluminea* or *Corbicula largillierti* for the Pantanal of Mato Grosso, with no reference to this species in the most recent survey of bivalves in the region (SERRANO et al. 1998).

The density of Corbicula (192 ind./m^2) in the Cuiabá River appears remarkably lower than the densities recorded in southern Brazil (5191 ind./m^2 according MANSUR & GARCES 1988), Argentina (2495 ind./m^2 by DARRIGRAN 1991) and North America (9257 ind./m^2 according ISOM (1986)). This fact may be mainly related to the recent colonisation of this region by this genus. Another factor that should be considered: when the water level of the Cuiabá River decreases during periods of pronounced drought and with the characteristic heat of the region under study, the water reaches temperature close to 40 °C, preventing the development of juvenile forms which are susceptible to temperatures higher than 30 °C.

This was determined in a study by McMAHON & WILLIAMS (1986), who monitored during a 22 month period, natural populations of *C. fluminea* submitted to the presence of thermal effluents and observed that the absolute upper lethal limit for this species is close to 36 °C, with acute (short-term) levels being reached between 42 and 47 °C. The authors noted that during the summer months populations were practically decimated and densities drastically reduced. McMAHON & WILLIAMS (1986) attribute this fact, among other factors, to the sensitivity of the mucilaginous cord of the byssus to temperatures close to 30 °C, which prevent the juvenile from fixing to the substrate.

It should also be considered that the reestablishment of Corbiculidae populations is extremely rapid (GARDNER et al. 1976; BRITTON & MORTON 1982; MORTON 1982; CHERRY et al. 1986; KRAEMER & GALLOWAY 1986). The knowledge about the behaviour of Corbiculidae in the Pantanal region should be necessary and compared to that native bivalves are adapted to the drastic changes in the environment, according to the flood pulse concept (JUNK et al. 1989; JUNK 2000) and to long periods of drought and high temperatures.

Data concerning the biometry and population density of *C. fluminea* have been reported by several investigators. In a study conducted on the Altamaha River in 1977, BRITTON & MORTON (1982) obtained mean length of 22.6 ± 4.6 mm, mean height of 20.4 ± 4.2 mm, mean width of 13.7 ± 2.6 mm, and density of 376.6 to 1215.9 ind./m^2; SICKEL (1986) reported shell lengths of 1.5 to 12.3 mm and density of 25 to 1825 ind./m^2 in the Tennessee River. CHERRY et al. (1986) reported that the density of *C. fluminea* was 20 to 30 shells/m^2 in the New River, Virginia, in 1976, increasing to 11,522 shells/m^2 in 1980. CORREA et al. (1992) in the lower part of Parana River, detected individuals with shell lengths ranging from 13.2 to 31.3 mm and densities ranging from 40 to 1660 ind./m^2, with a mean value of 538 ind./m^2.

The largest mean length value recorded for the region was 27.33 mm for *C. fluminea* at Station III-Santo Antônio. In studies of the populations of *C. fluminea* in the Althamaha River (Georgia), GARDNER et al. (1976) estimated that individuals measuring 18.5 to 28.0 mm in shell length were probably three years old. According ITUARTE (1985) figure 2, it is possible to recognise the gradual increase of the shell length of *C. fluminea*. It grows approximately 10 to 15 mm for each year. CATALDO & BOLTOVSKOY (1999) estimated the size range for the 1st year: 15.3-22.4 mm; for

the 2nd year: 23.5-27 mm, and the 3rd year: 27.5-29.3 mm for *C. fluminea* from Paraná River Delta. Using the data reported by ITUARTE (1985) and CATALDO & BOLTOVSKOY (1999), it is assumed that the arrival of this species to the Cuiabá River may have been recent, i.e., between 1996 and 1997 and that the populations of *C. fluminea* which lives in the southern part of South America grows faster in the first year than the populations in the USA.

The individuals from Punta Blanca, DARRIGRAN & MARONÑAS (1989) exhibit an the exponential pattern of growth, with maximal length equivalent to 41.99 mm for *C. fluminea and* 33.15 mm for *C. largillierti.* The pattern of growth of Corbiculidae from the Pantanal, as reflected by the relationship for between weight and length, seems also to be exponential.

The presence of the genus *Corbicula* in the Americas has been studied using different approaches. It is very important to point out that when biometric aspects are considered, such as length, two considerations should be kept in mind. The first is related to biotic factors, involving reproductive and growth patterns and the size of individuals in a population, which are genetically determined within the species. The second is related to abiotic factors, i.e., environmental characteristics such as food availability and physicochemical variables of the water that directly affect growth rate as shown, for example, by the relationship between weight and length, which vary considerably between the localities of these species.

Important observations should be emphasised when discussing the possible impacts caused by the presence of the genus *Corbicula* in the Pantanal region. However, more detailed population studies should be conducted in this region in order to obtain more information about the population of fresh water bivalves occurring there. Only on the basis of such data will it be possible to evaluate the impacts caused by the introduction of exotic species, the subject of the present study.

Conclusion

1) The recent finding of Corbiculidae in the headwaters of Paraguay and Grande Rivers shows that *Corbicula fluminea* and *C. largillierti* took about 25 years to occupy all the entire basin of the La Plata, Uruguay, Parana and Paraguay rivers since its arrival in the La Plata River estuary in the 1970's.

2) The arrival of Corbiculidae on the northern limits of the Pantanal of Mato Grosso is recent. Considering the estimated age of near three years for individuals with a maximum length of 27.33 mm, its arrival have occurred around 1996 and 1997.

3) The *C. fluminea* has a greater mean length than *Corbicula largillierti.* Through the relationship between shell length and weight both populations sampled in the Pantanal revealed a exponential tendency for exponential growth.

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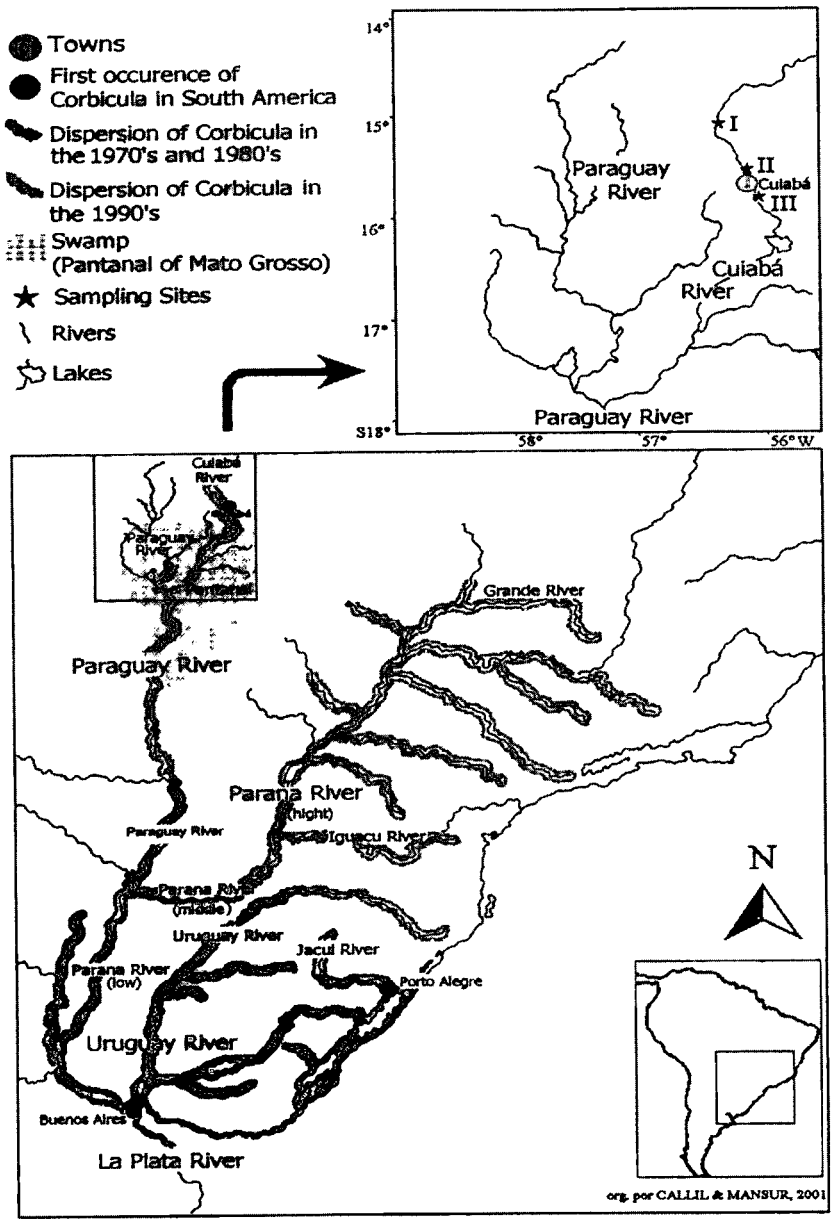

Fig. 1:
Schematic projection of the invasion of Corbiculidae in southeastern South America. The limits between decades are approximated.

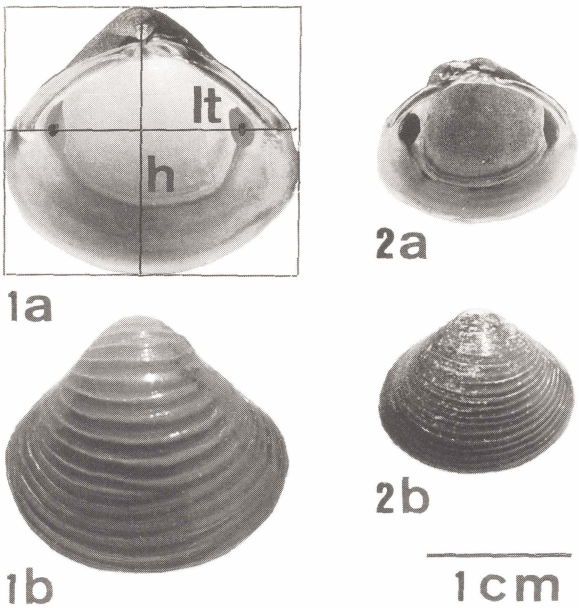

Fig. 2:
Internal and external view of Corbiculidae recorded in the Pantanal region, State of Mato Grosso, Brazil: **1a**, **1b** = *Corbicula fluminea* (MÜLLER, 1774); **2a**, **2b** = *C. largillierti* (PHILIPPI, 1844); **1a** = Methods of orientation and measurements of the shells: **Lt** = Length, **h** = height.

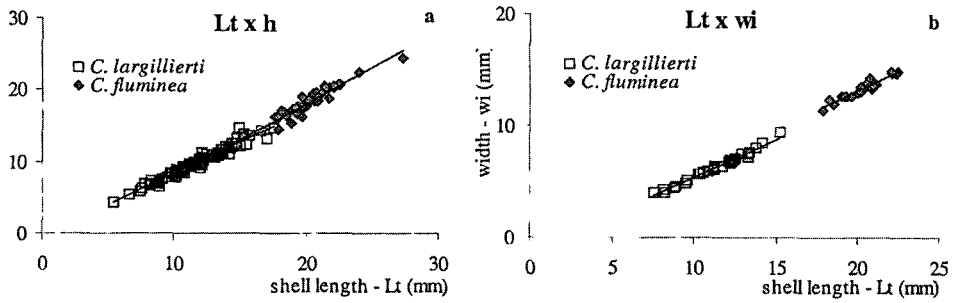

Fig. 3:
a: Shell length (Lt) x height (h), b: Shell length (Lt) x width (wi) of *Corbicula fluminea* (MÜLLER, 1774) and *C. largillierti* (PHILIPPI, 1844).

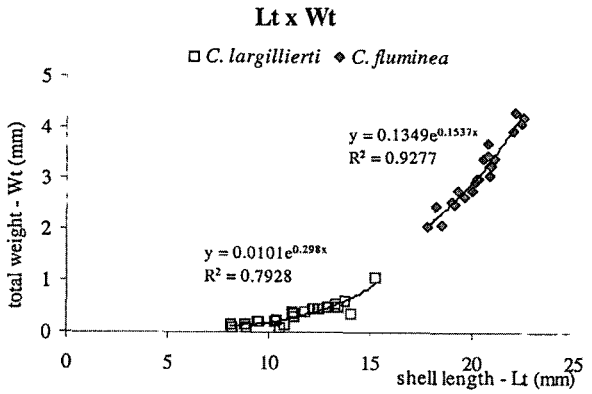

Fig. 4:
Shell length (Lt) x weight (Wt) of the *Corbicula fluminea* (MÜLLER, 1774) from Station III Santo Antônio do Leverger and *C. largillierti* (PHILIPPI, 1844) from Station I - Rosário do Oeste.

Table 1: Chronoloy of the invasion of the Southeast and Central part of South America by *Corbicula fluminea* (MÜLLER, 1774) and *C. largillierti* (PHILIPPI, 1844).

Year	Place	Species	Author
1978	Guaíba Lake, Patos Lagoon Basin, Rio Grande do Sul - Brazil	*Corbicula manilensis* (PHILIPPI, 1844) (= *Corbicula fluminea*)	VEITENHEIMER-MENDES (1981)
1979	Departaments of Colonia, Soriano and Rio Negro, Uruguay River - Uruguay	*Corbicula*	VEITENHEIMER-MENDES & OLAZARI (1983)
1979	Arroios Carnaval and Martín, La Plata Basin, Buenos Aires - Argentina	*Corbicula leana* PRIME, 1864 *Corbicula fluminea* (MÜLLER, 1774)	ITUARTE (1981)
1981/82	Barros, Fortaleza and Rondinha (small freshwater lakes near the coast), Rio Grande do Sul - Brazil	*Corbicula*	LANZER (1983); LANZER & SCHAEFER (1984)
1985/87	Taim swamp and Mirim Lake Basin, Rio Grande do Sul - Brazil	*Corbicula fluminea* (MÜLLER, 1774)	MANSUR & GARCES (1988)
1985/86	Magdalena - Prata River - Argentina	*Corbicula*	DARRIGAN & MARONAS (1989)
1982	Paraná River, Corrientes - Argentina	*Corbicula largillierti* (PHILIPPI, 1844) *Corbicula fluminea* (MÜLLER, 1774)	ITUARTE (1994)
1986/96	Upper, middle and lower Uruguay River	*Corbicula largillierti* (PHILIPPI, 1844) *Corbicula fluminea* (MÜLLER, 1774)	MANSUR (2000)
1997	Tibagi tributary of Paranapanema River, Paraná Basin, Paraná – Brazil	*Corbicula fluminea* (MÜLLER, 1774)	PEREIRA (1997)
1998/99	Rio Grande, Paraná Basin, Minas Gerais - Brazil	*Corbicula fluminea* (MÜLLER, 1774)	Personal information
1997	Canal Baía - Paraná Basin, Paraná - Brazil	*Corbicula fluminea* (MÜLLER, 1774)	TAKEDA et al. (2000)
1997/98	Cuiabá River, Paraguay Basin, Mato Grosso - Brazil	*Corbicula fluminea* (MÜLLER, 1774) *Corbicula largillierti* (PHILIPPI, 1844)	The present study

Table 2: Transversal distribution of *Corbicula fluminea* (MÜLLER, 1811) on the left side on the Cuiabá River, Station III - Santo Antônio do Leverger -MT on August 1st, 1999.

Margin distance (m)	Depth (cm)	Temp.H_2O (°C)	pH	OD mg/l	OD %	Cond. (µS/cm)	Number Ind.	Maximal Lt (mm)
1	1	30.4	7.95	10.2	142	68	0	---
2	1.5	30.7	8.11	9.4	130	78.1	3	10.65
3	3.5	30.2	7.83	10.1	136	83	1	7.2
4	3.5	29.8	7.99	8.1	110	85	0	---
5	5	29.4	7.94	8.4	108	86	12	13.57
6	6	29.3	7.95	8.9	119	86	0	---
7	4	28.8	7.94	8.5	114	87	0	---
8	4.5	28.9	7.90	8.4	114	87	5	9.56
10	9.2	27.9	7.83	7.7	103	87	2	8.53
12	14	27.0	7.74	7.10	91	74	4	21.76
14	20	20	7.69	7.69	89	87	3	24.15
16	21.5	21.5	7.74	7.74	85	87	4	20.59
18	22	22.0	7.75	7.75	86	87	1	19.22
20	28.5	28.5	7.70	7.70	84	86	1	25.84
22	31	31	7.72	7.72	84	87	1	22.63
25	29.5	29.5	7.77	7.77	84	87	0	--
Mean	12.79	27.80	7.84	8.32	104.93	83.88	Total = 37	16.7 mm

Table 3: Descriptive Statistic of biometrics parameters: length (Lt) and height (h), width (wi) and weight (Wt) of the *Corbicula fluminea* (MÜLLER, 1774) and *C. largillierti* (PHILIPPI, 1844).

Corbicula fluminea	**Lt (mm)**	**h (mm)**	**wi (mm)**	**Wt (g)**
N of cases	40	40	21	21
Minimum	14.740	12.240	11.400	2.050
Maximum	27.330	24.340	14.930	4.300
Median	20.165	18.455	13.360	3.000
Mean	20.041	18.169	13.373	3.121
95 % CI Upper	20.773	18.941	13.813	3.422
95 % CI Lower	19.309	17.396	12.934	2.821
S.D.	2.289	2.416	0.965	0.661
Variance	5.240	5.837	0.931	0.436
C.V.	0.114	0.133	0.072	0.212
Corbicula largillierti				
N of cases	86	86	29	28
Minimum	5.420	4.400	4.050	0.100
Maximum	17.530	14.760	9.420	1.050
Mean	11.630	9.728	6.313	0.366
95 % CI Upper	12.150	10.191	6.823	0.445
95 % CI Lower	11.110	9.265	5.803	0.287
S.D.	2.424	2.161	1.340	0.203
Variance	5.876	4.669	1.796	0.041
C.V.	0.208	0.222	0.212	0.555

Table 4: Results of ANOVA comparing the main variables, shell length (Lt), height (h), width (wi) and total weight (Wt), of *Corbicula fluminea* (MÜLLER, 1774) from Station III – Santo Antônio do Leverger and *C. largillierti* (PHILIPPI, 1844) from Station I - Rosário do Oeste.

Dependent variable	**MS**	**F**	**Sig.**
Lt	920.374	328.651	p>0.000
h	954.173	367.334	p>0.000
wi	575.737	378.129	p>0.000
Wt	88.296	334.463	p>0.000

Table 5: Values from of averages, standard deviation, regression and correlation indices (r^2) of biometrics parameters: shell length (Lt) and height (h) of the shells of *Corbicula fluminea* (MÜLLER, 1774) and *C. largillierti* (PHILIPPI, 1844).

Station & Species	Date	n	Lt (mm)	h (mm)	Equation	r^2
Rosário do Oeste *Corbicula largillierti*	VIII-1998	16	10.63±3.19	8.71±2.51	$h=3.1665e^{0.091\,Lt}$	0.9254
Rosário do Oeste *Corbicula largillierti*	VII-1999	17	13.57±1.97	11.39±2.04	$h=3.4179e^{0.087\,Lt}$	0.8934
Várzea Grande *Corbicula largillierti*	VIII-1998	24	11.21±1.97	9.42±1.82	$h=3.1332e^{0.096\,Lt}$	0.9479
Santo Antônio	VIII-1998	19	19.76±3.03	17.6±3.17	$h=5.6473e^{0.053\,Lt}$	0.9014

Table 6: Values from averages, standard deviation, regression and correlation indices (r^2) of biometric parameters: shell length (Lt) and weight (Wt) of *Corbicula fluminea* (MÜLLER, 1774) from Station III – Santo Antônio do Leverger and *C. largillierti* (PHILIPPI, 1844) from Station I - Rosário do Oeste.

Station & Species	n	Lt (mm)	Wt (g)	Equation	r^2
Santo Antônio - Station III *Corbicula fluminea*	21	20.30±1.34	3.12±0.66	$Wt = 0.1349\ e^{0.1537\,Lt}$ $LnWt = \ln 0.1349 + 0.1537.Lt$	0.93
Rosário do Oeste - Station I *Corbicula largillierti*	29	11.38±1.94	0.35±0.20	$Wt = 0.0101\ e^{0.298Lt}$ $LnWt = \ln 0.0101 + 0.298.Lt$	0.79