Aquatic Invasions (2009) Volume 4, Issue 4: 681-684
DOI 10.3391/ai.2009.4.4.14

Short communication

The Asian clam *Corbicula fluminea* (Müller, 1774) in the Guadiana River Basin (southwestern Iberian Peninsula): Setting the record straight

Pedro Morais[1,2*], Joaquim Teodósio[3], Joaquim Reis[4], Maria Alexandra Chícharo[1,5] and Luís Chícharo[1,5]

[1]*ICCE – Internat. Center for Coastal Ecohydrology, Palácio do Capitão-Mor, Horta das Figuras, EN125, 8005-518 Faro, Portugal*
[2]*CIMAR/CIIMAR – Centro Interdisciplinar de Investigação Marinha e Ambiental, Rua dos Bragas 289, 4050-123 Porto, Portugal*
[3]*SPEA – Sociedade Portuguesa para o Estudo das Aves, Avenida da Liberdade 105 2º Esq., 1250-140 Lisboa, Portugal*
[4]*Instituto Português de Malacologia, Zoomarine, EN 125, Km 65, Guia, 8200-864 Albufeira, Portugal*
[5]*CIMAR/CCMAR – Centro de Ciências do Mar, Faculdade de Ciências do Mar e do Ambiente, Campus de Gambelas, Universidade do Algarve, 8005-139 Faro, Portugal*
E-mail: pmorais@ualg.pt (PM), mchichar@ualg.pt (MAC), lchichar@ualg.pt (LC), joaquim.teodosio@spea.pt (JT), joaqreis@gmail.com (JR)
[*]*Corresponding author*

Received 20 March 2009; accepted in revised form 11 September 2009; published online 21 October 2009

Abstract

This paper aims to set the record straight regarding the first observations of *Corbicula fluminea* (Müller, 1775) in the Guadiana River Basin. According to the available data, *C. fluminea* was first observed in 1988 and not in 2006 as suggested by Pérez-Bote and Fernandéz (2008). The first observations of *C. fluminea* in the Guadiana estuary were reported in 2000. In 2003, *C. fluminea* was already well established in the estuary and in many rivers and streams. *C. fluminea* is likely to expand its current biogeographic distribution in Portugal, since suitable lentic habitats for colonization will be created by the implementation of the "National program of dams with high hydraulic potential", which should be concluded by 2016.

Key words: *Corbicula fluminea*, Guadiana River Basin, Guadiana estuary, dams, Portugal

The Asian clam *Corbicula fluminea* (Müller, 1774) is one of the 100 worst invasive species in Europe (DAISIE 2009). It was first noticed in the Iberian Peninsula in 1980, in the Tagus estuary (Mouthon 1981). Pérez-Bote and Fernández (2008) stated that *C. fluminea* was first recorded in the Guadiana River Basin (southwestern Iberian Peninsula, Figure 1) in June 2006, more precisely in the rivers Lacarón and Lobón and in the Montijo reservoir. However, Pérez-Quintero (1990) had already registered the presence of *C. fluminea* in Rivera Grande de la Golondrina (Lower Guadiana River basin) in 1988. In March 2000, the first observations of *C. fluminea* in the Guadiana estuary were registered in Guerreiros do Rio (37º23'52"N, 7º26'45"W), during a survey to identify the bivalves occurring along the first 40 kilometers of the estuary (Chícharo et al. 2000). More specimens of *C. fluminea* were collected from subtidal areas of the upper estuary (Figure 2), from Foz de Odeleite (station 3) to Alcoutim (station 8).

In 2003, seventy seven sites were surveyed along the entire Portuguese Guadiana Basin and *C. fluminea* was present in 28.6% of these sites (Figure 2, Annex 1). The density of *C. fluminea* varied between 7 and 360 Captures Per Unit Effort (CPUE, as number of bivalves per researcher per hour of search), averaging 130 CPUE. In the Guadiana estuary, *C. fluminea* extended along 52 km of the estuary (Figure 2), from near Foz de Odeleite (station 3) to Mértola (station 16) (Figure 2). Another four species belonging to the family Unionidae were found, namely: *Anodonta anatine* (Linnaeus, 1758), *Potomida littoralis* (Cuvier, 1798), *Unio delphinus* Spengler, 1793 (replaces *Unio pictorum* (Linnaeus, 1758) in the Iberian Peninsula, see Barea-Azcon et al. 2008) and *Unio tumidiformis* Castro, 1895 (replaces *Unio crassus* Retzius, 1788) in the Iberian Peninsula (for these species see revised taxonomy in Reis and Araujo 2009).

C. fluminea is currently known to be present in several tributaries of the River Guadiana and estuary, namely in the following rivers: Alvacar,

Figure 1. Geographical context of the Guadiana river basin in the Iberian Peninsula (Europe). Map modified from http://www.maps-for-free.com

Beliche, Carreiras, Cobres, Degebe, Foupana, Limas, Odeleite, Oeiras, Terges and Vascão and in Lake Mina de São Domingos (Reis 2006). In the river Guadiana, the distribution range of *C. fluminea* seems to have increased downstream of the Alqueva dam (Figure 1), since the closure of its gates in February 8th, 2002.

In Portugal, *C. fluminea* is also present in Minho, Lima, Douro, Vouga, Mondego, Lizandro, Tagus and Sado river basins (Reis 2006). The "national program of dams with high hydraulic potential" has the potential to cause a greater proliferation of *C. fluminea* in Portugal, increasing its biogeographic distribution and local abundances. Eleven new dams are scheduled to be built under this program until 2016, so that non-used hydraulic potential decreases from 54% to 33% (Garcia 2009). This will certainly create suitable lentic habitats for colonization of *C. fluminea* (Pérez-Quintero 2008) and other non-indigenous freshwater aquatic species (Johnson et al. 2008). It is important to emphasize that the population dynamics of aquatic invasive species are better understood if the timing of introductions is known as accurately as possible. Moreover, biological invasions can only be eradicated if they are detected on time, but the best policy is still to prevent them. Thus, we urge for the creation of monitoring projects aiming both to evaluate the conservation status of native bivalves and to detect, as soon as possible, the introduction of non-native species.

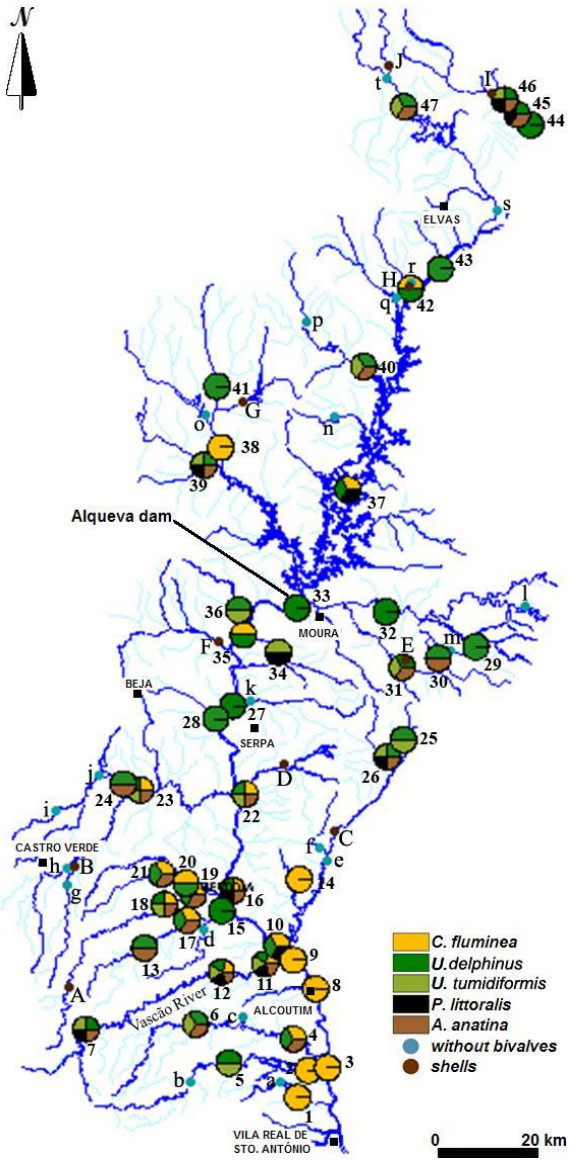

Figure 2. Specific diversity of freshwater bivalves along the Portuguese Guadiana river basin in the summer of 2003

Acknowledgements

The PhD and Post-Doc scholarships of Joaquim Reis (SFRH/BD/12687/2003), Joaquim Teodósio (SFRH/BD/8490/2002) and Pedro Morais (SFRH/BPD/40832/2007) were funded by Fundação para a Ciência e a Tecnologia. The PhD scholarship of Joaquim Teodósio supported the 2003 survey. The English revision of the manuscript was made by our colleague Pedro Range.

References

Barea-Azcón J, Ballesteros-Duperón E, Moreno D (coords) (2008) Libro rojo de los invertebrados de Andalucia (4 tomos). Consejería de Medio Ambiente. Junta de Andalucia. Sevilla

Chícharo L, Chícharo MA, Amaral A, Condinho S, Dias S, Morais P, Vaz Pinto G (2000) Valorização dos recursos pesqueiros do estuário do Guadiana. Relatório final do projecto ODIANA-VALPEG. Universidade do Algarve. Faro

DAISIE (2009) Delivering alien invasive species inventories for Europe (DAISIE). http://www.europe-aliens.org (Accessed 13 May 2009)

Garcia R (2009) Bruxelas investiga programa de barragens. Público Online. http://www.publico.pt (Accessed 19 January 2009)

Johnson, PTJ, Olden JD, Zanden MJV (2008) Dam invaders: impoundments facilitate biological invasions into freshwaters. Frontiers in Ecology and the Environment 6: 357-363, doi:10.1890/070156

Mouthon J (1981) Sur la présence en France et au Portugal de *Corbicula* (Bivalvia, Corbiculidae) originaire d´Asie. Basteria 45: 109-116

Pérez-Bote JL, Fernández J (2008) First record of the Asian clam *Corbicula fluminea* (Müller, 1774) in the Guadiana River Basin (southwestern Iberian Peninsula). Aquatic Invasions 3: 87-90, doi:10.3391/ai.2008.3.1.14

Pérez-Quintero JC (1990) Primeros datos sobre la presencia de *Corbicula fluminea* en España. I. Biometría. Scientia Gerundensis 16: 175-182

Pérez-Quintero JC (2008) Revision of the distribution of *Corbicula fluminea* (Müller, 1774) in the Iberian Peninsula. Aquatic Invasions 3: 355-358, doi:10.3391/ai.2008.3.3.13

Reis J (2006) Atlas dos bivalves de água doce de Portugal Continental. ICN. Lisboa

Reis J, Araujo R (2009) Redescription of *Unio tumidiformis* Castro, 1895 (Bivalvia, Unionidae), an endemism from the south-western Iberian Peninsula. Journal of Natural History 43: 1929-1245, doi:10.1080/00222930902993724

Annex 1. Location of sampling sites, in the lower Portuguese Guadiana river basin, surveyed in the summer of 2003 to collect freshwater bivalves. Legend for Station: numbers- locations with bivalves; capital letters - locations only with empty shells; lowercase letters - locations without bivalves

Station (map ref)	Location	Coordinates		Recorded species				
		Latitude, N	Longitude, W	*C. fluminea*	*A. anatina*	*P. littoralis*	*U. delphinus*	*U. tumidiformis*
1	Ribeira do Beliche	37°16'38"	7°30'24"	+				
2	Ribeira de Odeleite	37º20'04"	7°29'06"	+				
3	Estuário do Guadiana	37°19'39"	7°26'22"	+				
4	Ribeira da Foupana	37°23'04"	7°31'20"	+	+		+	
5	Ribeira de Odeleite	37°19'56"	7°38'48"				+	+
6	Ribeira da Foupana	37°24'17"	7°44'16"		+		+	+
7	Ribeira do Vascão	37°23'48"	7°59'04"		+	+	+	+
8	Estuário do Guadiana	37°28'12"	7°28'11"	+				
9	Estuário do Guadiana	37°31'30"	7°30'47"	+				
10	Estuário do Guadiana	37°32'57"	7°33'07"	+		+	+	
11	Ribeira do Vascão	37°30'55"	7°34'54"	+	+	+	+	+
12	Ribeira do Vascão	37°30'11"	7°40'40"	+	+	+	+	+
13	Ribeira de Carreiras	37°32'47"	7°51'25"		+		+	
14	Barragem da Tapada Grande	37°40'11"	7°30'19"	+				
15	Ribeira de Carreiras	37°36'37"	7°40'33"				+	
16	Estuário do Guadiana	37°38'45"	7°39'06"	+	+	+	+	
17	Ribeira de Carreiras	37°35'39"	7°45'26"	+	+		+	
18	Ribeira de Oeiras	37°37'28"	7°48'18"	+	+		+	+
19	Ribeira de Oeiras	37°38'30"	7°44'48"	+	+			
20	Ribeira de Alvacar	37°39'37"	7°45'24"	+			+	
21	Ribeira de Alvacar	37°41'08"	7°49'04"	+	+		+	
22	Ribeira de Limas	37°49'21"	7°37'21"	+	+		+	+
23	Ribeira de Cobres	37°49'46"	7°51'48"	+	+		+	+
24	Ribeira de Terges	37°50'34"	7°53'48"		+		+	
25	Rio Chança	37°54'50"	7°15'55"				+	+
26	Ribeira de Vidigão	37°53'37"	7°18'11"		+	+	+	+
27	Rio Guadiana	37°58'50"	7°39'18"				+	

Annex 1 (continued)

Station (map ref)	Location	Coordinates		Recorded species				
		Latitude, N	Longitude, W	*C. fluminea*	*A. anatina*	*P. littoralis*	*U. delphinus*	*U. tumidiformis*
28	Ribeira de Cardeira	37°57'18"	7°41'14"				+	
29	Ribeira do Murtigão	38°05'20"	7°05'51"				+	
30	Ribeira de Safareja	38°03'51"	7°10'51"		+		+	
31	Ribeira de São Pedro	38°03'30"	7°15'54"		+		+	+
32	Rio Ardila	38°08'54"	7°17'38"				+	
33	Rio Guadiana	38°09'26"	7°30'24"				+	
34	Ribeira do Barranco do Panasco	38°05'06"	7°32'54"			+		+
35	Rio Guadiana	38°06'47"	7°37'32"	+			+	
36	Ribeira de Marmelar	38°09'32"	7°38'48"				+	+
37	Barragem de Alqueva	38°21'45"	7°23'39"	+		+	+	
38	Rio Degebe	38°26'37"	7°40'50"	+				
39	Ribeira da Azambuja	38°25'23"	7°42'55"		+	+	+	+
40	Ribeira de Lucefece	38°35'53"	7°20'49"		+		+	+
41	Ribeira da Pardiela	38°32'48"	7°41'07"				+	
42	Rio Guadiana	38°43'45"	7°14'55"	+			+	
43	Rio Guadiana	38°46'13"	7°11'19"				+	
44	Ribeira do Xévora	39°01'48"	6°57'34"				+	
45	Ribeira do Xévora	39°03'11"	6°59'35"		+	+	+	
46	Ribeira do Xévora	39°04'49"	7°01'05"		+	+	+	+
47	Barragem do Caia	39°03'03"	7°13'43"		+		+	+
A	Ribeira de Oeiras	37°28'33"	8°01'31"					
B	Ribeira de Cobres	37°41'27"	8°00'55"					
C	Rio Chança	37°45'12"	7°25'19"					
D	Ribeira de Limas	37°52'38"	7°32'14"					
E	Ribeira de Toutalga	38°03'56"	7°15'48"					
F	Ribeira de Odearce	38°05'59"	7°40'58"					
G	Ribeira de Vale de Vasco	38°32'15"	7°36'50"					
H	Rio Guadiana	38°44'20"	7°14'07"					
I	Ribeira de Abrilongo	39°05'31"	7°02'58"					
J	Ribeira de Arronches	39°08'01"	7°16'38"					
a	Ribeira do Beliche	37°18'01"	7°32'23"					
b	Ribeira de Odeleite	37°17'59"	7°44'51"					
c	Ribeira da Foupana	37°24'51"	7°37'47"					
d	Ribeira da Lampreia	37°34'28"	7°43'07"					
e	Rio Chança	37°42'03"	7°26'21"					
f	Ribeira dos Alcaides	37°43'50"	7°27'37"					
g	Ribeira de Cobres	37°39'07"	8°01'40"					
h	Ribeira da Maria Delgada	37°41'33"	8°01'45"					
i	Ribeira da Cinceira	37°47'40"	8°03'17"					
j	Ribeira de Terges	37°51'31"	7°57'15"					
k	Ribeira de Grafanes	37°59'38"	7°36'32"					
l	Ribeira de Murtéga	38°09'25"	6°59'51"					
m	Ribeira de Santo Aleixo	38°05'06"	7°09'32"					
n	Ribeira do Azevel	38°30'05"	7°25'48"					
o	Rio Degebe	38°30'42"	7°42'38"					
p	Ribeira de Lucefece	38°40'30"	7°28'52"					
q	Rio Guadiana	38°43'03"	7°16'32"					
r	Ribeira de Mures	38°44'49"	7°14'12"					
s	Rio Caia	38°52'24"	7°02'12"					
t	Rio Caia	39°07'04"	7°17'07"					